Sequoia & Kings Canyon National Parks

National Park Service
U.S. Department of the Interior

Fire and Fuels Management Plan
2014 Annual Update

EA/FONSI completed in 2003
Updated
2004
2005
2006
2007
2008 (5 year review)
2009 (National Policy Guidelines incorporated)
2010
2011
2012
2013 (Five Year Review)
2014

Table of Contents

List of Figures and Tables

List of Figures

List of Tables

Crosswalk Between RM-18 and This Plan

DESCRIPTION AND PURPOSE OF CROSSWALK

National Park Service policy, articulated in *Directors Order 18 - Wildland Fire Management* (1998) and *Reference Manual-18* (2008), requires that all parks with vegetation capable of supporting fire develop a fire management plan. Chapter 4 of RM-18 (approved in November of 2002, updated in 2010) provides a standard outline for such plans.

Using the RM-18 standard outline as a starting point, Sequoia and Kings Canyon National Parks (SEKI) developed an outline that will benefit the fire and fuels program in these parks. While all necessary elements from the standard outline are present, they are organized differently in a way that better reflects the resources, issues, and management program here at SEKI.

The first column of the following table lists all the elements of the standard fire management plan outline from *Reference Manual 18*. The second column of the table lists the section of this *Fire and Fuels Management Plan* where the same information is located.

Elements of Standard *RM-18* Fire Management Plan Outline	Location of Same Information in this Fire and Fuels Management Plan
Table of Contents	Table of Contents
List of Figures	List of Figures and Tables
List of Tables	List of Figures and Tables
Part I - Introduction Reasons for developing plan Other purposes of the plan General description of the park Management Environment Environmental Compliance	 Chapter 1 Chapter 1 and Appendix B Chapter 1, Chapter 8 Chapter 1 Chapter 1 and Appendix B
Part II – Policy, Land Management Planning, and Partnerships Fire Policy Park/Resource Management Planning Partnerships	 Chapter 1 Chapter 1 Chapter 1, Appendix B
Part III – Park-wide Fire Management Unit Characteristics Park-wide fire management considerations Fire Management Goals and Objectives Wildland Fire Management Actions Fire Management Unit Specific Characteristics	 Chapter 2, Chapter 4 Chapter 2 Chapter 2, Chapter 3; Tools 1 &2 Chapter 4
Part IV – Wildland Fire Management Operational Guidance Safety Preparedness Management Of Unplanned Ignitions Burned Area Emergency Response Management Of Planned Fuels Treatments Prevention, Mitigation, and Education	 Chapter 7 Chapter 3, Tool 1 & Appendix O Chapter 3, Tool 2, Chapter 10 Chapter 3 , Tool 2 Chapter 3, Tool 3 & 4, Appendix N Chapter 3, Tool 5, Appendix M

Elements of Standard *RM-18* Fire Management Plan Outline	Location of Same Information in this Fire and Fuels Management Plan
Air Quality and Smoke Management Data & Records Management Organizational and Budgetary Parameters	Chapter 3, Tools 2 & 3, Chapter 8, Appendix I & J Chapter 3, Tool 2, 3 &4, Appendix N Chapter 6
Part V – Adaptive Management Strategy Fire Management Objectives Monitoring Evaluation Fire Research	 Chapter 2, Chapter 3, Tool 6, Appendix C Chapter 3, Tools 2, 3, & 4, Appendix L Chapter 3, Tool 7, Appendix D

1. Why Write a Plan?

NEED FOR THIS PLAN

Wildland fire has long been recognized as one of the most significant natural processes operating within and shaping Sierra Nevada ecosystems. Virtually all vegetation communities show evidence of fire dependence, adaptation or tolerance. At the same time, wildland fire has the potential to threaten human lives and property. Consequently, there is a need to manage wildland fire so that threats to humans and property are reduced, while at the same time restoring and/or maintaining its function as a natural process.

Sequoia and Kings Canyon National Parks have written this *Fire and Fuels Management Plan* to provide long-term direction for achieving park goals related to human safety and ecosystem management. The plan also satisfies the requirements and direction provided in policy, legislative authority, park purpose statements, higher-level planning documents, and natural and cultural resource management objectives. Each one of these components is discussed below.

POLICY

National Park Service policy, articulated in *Directors Order 18 - Wildland Fire Management* (2008) and *Reference Manual-18* (2008), require that all parks with vegetation capable of supporting fire develop a fire management plan:

"Each park with burnable vegetation must have an approved Fire Management Plan that will address the need for adequate funding and staffing to support its fire management program. Parks having an approved Fire Management Plan and accompanying National Environmental Policy Act (NEPA) compliance may utilize wildland fire to achieve resource benefits in predetermined fire management units. Parks lacking an approved Fire Management Plan may not use resource benefits as a primary consideration influencing the selection of a suppression strategy, but they must consider the resource impacts of suppression alternatives in their decisions."

Other program direction comes from the National Fire Plan (based on Managing the Impact of Wildfires on Communities and the Environment, A Report to the President in Response to the Wildfires of 2000), the 10-Year Comprehensive Strategy (A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment), the Federal Wildland Fire Management Policy and Program Review (2001), NPS Management Policies (2006), Guidance for Implementation Federal Management Policy (2009), A National Cohesive Wildland Fire Management Strategy (2013) and all other applicable laws, policies, regulations, and procedures.

Policy also directs Sequoia and Kings Canyon National Parks to work cooperatively with their adjacent land management and fire management agencies to implement mutually beneficial projects and programs. This plan provides guidance not only for park staff, but also the parks' neighbors. With clearly stated program goals and objectives, the parks' neighbors will be better able to comment on park planning efforts and provide technical assistance.

LEGISLATIVE AUTHORITY

Authority for carrying out a fire and fuels management program originates with the Organic Act of the National Park System, August 25, 1916. This Act states that the primary goal of the National Park Service is to preserve and protect the natural and cultural resources found on lands under its management in such manner as will leave them unimpaired for future generations. Additional authorities for fire management activities include: 31 U.S. Code 665 (E) (1) (B) which provides the authority to exceed appropriations due to wildland fire management activities; Section 302 (c) (2) of the Federal Property Administration Services Act of 1949, as amended; and Chapter VIII of the 1983 Supplemental Appropriations Act (P.L. 97-257) which deals with contracting for fire protection; and The Reciprocal Fire Protection Act, Act of May 27, 1955 (42 U.S.C. 1856) that authorizes reciprocal agreements with federal, state, and other wildland fire protection organizations.

PURPOSE OF SEQUOIA AND KINGS CANYON NATIONAL PARKS

Sequoia and Kings Canyon National Parks protect a variety of landscapes containing biological and cultural resources in the southern Sierra Nevada of California. They are two separate national parks that were created by acts of Congress fifty years apart. Today these parks are administered as a single unit. Primary purposes of the two parks as expressed in legislation are to preserve the forest resources, particularly the giant sequoia groves, and to protect a vast wilderness for both its scenic and recreational values.

Established September 25, 1890, Sequoia National Park is the second oldest national park in the United States. The campaign to create the park focused on the giant sequoia groves (*Sequoiadendron giganteum*). The October 1, 1890 act also created four-square-mile General Grant National Park to protect the General Grant Tree and surrounding forest.

Since 1890, Sequoia National Park has undergone two major enlargements, both of which added high Sierra lands to the park. In 1926, Congress added the Great Western Divide, Kern headwaters, and Sierra Crest regions. This enlargement, which more than doubled the park's acreage, made it clear that Sequoia National Park would be not only a forest park, but also an alpine park. Included within the enlargement was Mt. Whitney, the highest mountain in the contiguous United States. In 1978, Congress again enlarged Sequoia National Park, this time adding the Mineral King area to the park, which previously had been a part of the Sequoia National Forest. Congress added the basin to the national park with the specific instruction that it would be preserved undeveloped. In 2000, the park was further expanded with the addition of the Dillonwood Grove, a private tract of sequoia grove adjacent to the park's southern boundary within the Tule River watershed. Today, the best known and most appreciated features of Sequoia National Park remain the sequoia groves and the high country.

The small General Grant National Park existed unchanged for fifty years. Then in 1940 Congress created Kings Canyon National Park. In addition to incorporating the four square miles of General Grant National Park and several other adjacent sequoia groves, Kings Canyon National Park also featured the great glacial canyons and scenic alpine headwaters of the South and Middle Forks of the Kings River. Because the new park contained two separate tracts, one featuring giant sequoia trees and the other canyons and alpine scenery, Kings Canyon's dual nature was readily apparent from the beginning. In 1940, as a political compromise, the floors of the park's two great glacial canyons were left outside its boundaries as possible reservoir sites.

This situation was resolved in 1965 when Congress added the floors of Kings Canyon and Tehipite Valley to the park.

Sequoia and Kings Canyon National Parks contain resources of geological, biological, cultural, and sociological value. In addition to national park status, the two reservations have also been designated as a unit of the International Biosphere Preserve Program, and 85% of the parks have been designated wilderness. For a detailed description of park resources, please see Chapter 8.

RELATIONSHIP TO HIGHER-LEVEL PLANNING DOCUMENTS

Environmental Assessment

The program described in this plan was developed following guidelines and requirements of the National Environmental Policy Act and National Historic Preservation Act. A companion *Environmental Assessment* (EA) provides details on the alternatives considered, and an environmental assessment of the actions described in this document. Any user of this plan must become thoroughly familiar with the EA to fully understand the context and expected impact of the actions implemented by this plan.

General Management Plan

The parks General Management Plan (2007) provides the primary direction for management of natural resources in these parks. The General Management Plan expresses natural resource and fire management goals in a general way that provides the guidance for the development of this Fire Management Plan

The General Management Plan (page 88) states that the parks are to, "Manage wildland fire to address its profound ecological role in park ecosystems and its potential impacts on public safety, health, well-being, and property." The General Management Plan (page 27) specifically identifies that the past exclusion of fire has had significant negative impacts on the park environment and directs fire management to continue the program began in 1968 to restore the natural role of fire. In addressing rapid anthropogenic climatic change, the General Management Plan (page 29) states that, "the resilience of forest to climatic change…can be increased by restoring a more open structure to the forest" and that a "natural-like fire regime will play an integral role in preserving park landscapes."

Objectives and strategies that accomplish the visions and concepts of the General Management Plan as they pertain to wildland fire are to be identified in the Fire Management Plan.

Wilderness Plan

The parks currently manage wilderness areas under a *Backcountry Management Plan (1986)*. That plan will be replaced by a *Wilderness Stewardship Plan, which was initiated in early 2011. A*s with the GMP (completed in 2007), once the *Wilderness Stewardship Plan* is complete, the *Fire and Fuels Management Plan* will be reviewed for conformity. If there are discrepancies between the two plans, the *Wilderness Stewardship Plan* will take precedence and the *Fire and Fuels Management Plan* will be amended to comply.

Strategic Plan

The parks' *Strategic Plan* outlines specific actions that the parks expect to take to fulfill parkwide goals and objectives. As such, that plan will include specific annual and long term objectives and actions described in the *Resource Management Plan* and *Fire and Fuels Management Plan*.

Natural and Cultural Resources Management Plan

The *Natural and Cultural Resources Management Plan* (RMP) (1999) translates general direction provided in the *Master Plan* (or GMP) into more specific direction and recommendations for management of park resources. Actions detailed in the *Fire and Fuels Management Plan* respond to and help fulfill resource management objectives articulated in the RMP.

The primary resource management goal for fire management is contained in Mission Goal 1a. It states that "natural and cultural resources and associated values are protected, restored, maintained in good condition, and managed within their broader ecosystem and cultural context."

To accomplish the mission goal, the following actions are recommended:

Vegetation

- Native plants are preserved as part of natural functioning ecosystems
- The giant sequoia groves – particularly Giant Forest – and the ecosystems they occupy are restored, maintained, and protected.
- Plant communities that have been altered by fire suppression are restored/maintained through restoration of the natural fire regime to the maximum extent possible.
- Vegetation in the parks' Development Zone is restored and/or maintained as a healthy, vigorous vegetative community that approximates the "natural" state, given the constraints of past and present human intervention, while providing a safe environment for human use and enjoyment.

Aquatic/Water

- Aquatic and water ecosystems are restored and/or maintained so that physical, chemical, and biotic processes function uninfluenced by human activities
- A long-term monitoring program is developed to record ambient conditions and to document changes and trends in physical and chemical characteristics and biotic communities.
- Changes within the aquatic environments that are caused by facilities, management activities, or visitor use patterns are located and documented and unnatural changes are mitigated to the extent feasible.

Wildlife

- Natural populations of wildlife in which animal behavior and ecological processes are essentially unaltered by human activities are perpetuated

- Native animal species and threatened/endangered and sensitive animal species are inventoried, monitored, protected, and restored/maintained over time.

Air Resources

- Air quality is restored to natural conditions
- Impacts and levels of park air pollution are monitored.
- Knowledge about Park Natural Resources
- Knowledge of the state of the parks' natural resources continues to grow
- Scientific research that promotes an understanding of the parks' resources and the impacts that affect those resources is encouraged.
- The general ecosystem elements and processes of the parks, the natural forces controlling them, and the potential for human activities to affect them are increasingly understood.

Prehistoric and Historic Archeological Sites

- Actions are taken to protect threatened or adversely impacted significant sites from threats or on-going impacts.

Historic Structures

- Actions are taken to protect threatened or adversely impacted historic structures from threats or on-going impacts.

Cultural Landscapes

- Actions are taken to protect threatened or adversely impacted significant cultural landscapes from threats or on-going impacts.
- Knowledge about Park Cultural Resources
- Knowledge of the state of the parks' cultural resources continues to grow
- Scientific research that promotes a better understanding of the parks' cultural resources and museum collections is encouraged.

California State Air Quality Planning

Actions taken under this plan will conform to the limits and requirements of the *State Implementation Plan* for attainment of National Ambient Air Quality Standards. Projects implemented under this plan will conform to the legal and procedural requirements of the San Joaquin Valley Unified Air Pollution Control District. Annual and project level plans that involve the use of fire will be reviewed by the District and implemented after consultation with the District. Procedures for District review and permitting, and for implementation of Best Available Control Methods (BACM) are found in Appendix J.

PARTNERSHIPS

This plan fulfills the interagency and NPS requirements for interagency fire management planning. All actions described and implemented under this plan consider the need to manage fire across landscapes with other federal, state, and local agencies. The parks actively participate in the Southern Sierra Fire Management Officers (SSFMO) group to ensure a strategic and comprehensive fire response in the region. Memberbership in the SSFMO includes five national forests (Humboldt-Toiyabe, Inyo, Sequoia, Sierra, & Stanislaus), two national parks (Sequoia & Kings Canyon and Yosemite), and the Bakersfield Field Office of the Bureau of Land Management.

WHAT THIS PLAN WILL DO

Based on the authorities and direction explained above, this plan provides a detailed description of how Sequoia and Kings Canyon National Parks will organize and implement its fire and fuels management program. The *Fire and Fuels Management Plan* will:

- Provide overall program direction by stating mission, goals, and objectives.
- Describe fire and fuels management tools, prescriptions, and operational procedures.
- Designate and describe fire management zones, planning units, and segments.
- Describe planning procedures.
- Provide guidance on the protection of sensitive resources.
- Describe the fire and fuels management organization structure.
- Highlight the importance of safety.
- Summarize the historical role of fire in the parks and the current wildland fire situation.

The *Fire and Fuels Management Plan* undergoes periodic review as part of a continuing refinement process. The Plan will be reviewed annually and amended as needed to comply with changing policy, law, and circumstances. Topics considered for revision are discussed each spring during the annual fire and fuels management review. Revisions will be made in accordance with DO-18 Wildland Fire Management and RM-18 Wildland Fire Management Reference Manual.

Any significant change in fire management practices identified in this plan will be evaluated by the parks' NEPA Compliance Specialist to determine whether the actions warrant further environmental compliance. Environmental assessments will be prepared for actions that are not covered under the companion *Environmental Assessment* for this plan or are exceptions to categorical exclusions contained in Directors Order 12 - Conservation Planning, Environmental Impact Analysis, and Decision-making.

2. Mission, Goals, and Objectives of Program

Sequoia and Kings Canyon National Parks will institute an adaptive management strategy for the fire and fuels management program consistent with the direction and constraints contained in the companion *Environmental Assessment* (EA). Combining this adaptive management strategy with the park purpose and other guidance outlined in Chapter 1, the parks have developed a concise, yet flexible, framework for the fire and fuels management program.

The program is defined by an overarching mission statement, three broad goals, four program objectives, a set of target conditions, and eight primary tools. All of these elements, excluding the target conditions, are visually represented in Table 2-1.

While the tools are introduced here, they are thoroughly discussed in Chapter 3. Target resource conditions are described in detail in the *Fire and Fuels Monitoring Plan* (Appendix C).

MISSION STATEMENT

Our Mission is to use the full range of options and strategies available to manage wildland fire, a process with the power to dramatically alter natural and cultural environments, by:

- Protecting park resources, employees and the public from unwanted fire.
- Building and maintaining fire resilient ecosystems using the full range of fuel treatment options.
- Reducing the threat to local communities from wildfires emanating from the parks or adjacent lands.
- Recruiting, training and retaining a professional fire management workforce.
- Working cooperatively with all staff to achieve park goals.

GOALS

To accomplish the mission statement above, the parks recognize the necessity of managing three elements - values, hazards, and risks - in wildland fire areas. Defined below, these form the basis for the program's three broad goals:

Protect and restore the parks' ecological, cultural, and social values. Ecological values include vegetation, water, wildlife, natural processes, and air resources. Cultural resource values include prehistoric and historic cultural sites, historic structures, and contemporary structures, both government-owned and private. Social values include park employees, visitors, neighboring communities, and wilderness.

Reduce fire hazards in park ecosystems. Fire hazard is defined as those attributes that affect the ability to control fires, or contribute to extreme fire behavior. Certain elements that contribute to hazardous fire conditions, such as steep slopes and the amount of solar radiation that heats fuels and dries vegetation, cannot be changed by management actions. Fuel conditions, however, can be effectively altered by management actions and are the focus of most hazard fuel reduction activities.

- Reduce risk of unwanted wildland fire. Risk is defined as the probability of new fire starts, whether by human or natural ignitions (lightning). Since lightning ignition risk is outside the realm of management control, the focus of the risk portion of the fire management program is to reduce the probability of unwanted human ignitions.PROGRAM OBJECTIVES

To focus planning and operations, the parks have developed four program objectives that begin to specify the major tasks facing the fire and fuels management staff. Consistent attention to these objectives will achieve the three broad program goals.

1. Manage all unplanned wildland fires commensurate with the values at risk.

- Manage all wildland fires, regardless of ignition source or the location of ignition, using strategies and tactics commensurate with protection of human health, safety, and natural and cultural resource values, as described in this approved *Fire and Fuels Management Plan*.
- Utilizing existing interagency wildland fire planning procedures, analyze risks and complexities for all ignitions in order to determine those ignitions which can be successfully managed for the benefit of ecological and life/safety values and those that should be suppressed.

2. Plan and implement appropriate treatments to reduce the threat to values from unwanted wildland fire and to restore or maintain ecological values.

- Annually, analyze fire hazards, values, and risks so that projects are designed within Fire Management Units (FMUs).
- Using GIS and fire behavior models to plan treatments, ecological, life/safety, infrastructure, and cultural resource values will be analyzed and updated yearly through feedback from monitoring and research advances.
- Consider and mitigate during the planning phase negative impacts to cultural and natural resources that might result from management operations.

3. Understand the consequences of fire management actions.

- Monitor and evaluate the effects of fire and fuels management activities on park natural and cultural resources with particular attention to vegetation, water, wildlife, air, and cultural resources.
- Evaluate monitoring information to refine the management activities and objectives, and prescription range values as appropriate.
- For vegetation, utilize ecosystem “restoration” and “maintenance” target conditions developed as one benchmark of program success (see Appendix C).
- Work to ensure that particulates produced by prescribed and use of wildland fire remain within all federal, state, and local air resource objectives by monitoring smoke in cooperation with the San Joaquin Valley Unified Air Pollution Control District.
- Identify issues or missing information needs that, once known, will lead to more effective implementation of the parks’ fire and fuels management program.
- Conduct research as issues or information gaps are identified through monitoring and evaluation of fire management activities.
- Understand public attitudes and political concerns through personal contacts, social science research, and other avenues. Incorporate this information into management decisions as appropriate.

4. Provide current and accurate information on wildland fire and fuels management activities to the public, the park workforce, and cooperating agencies.

- Provide interpretive and educational programs designed to enhance public and staff understanding and awareness of fire ecology and wildland fire management.

Table 2-1: Fire and Fuels Management Program: Mission, Goals, Objectives, and Tools

			TOOLS					
Fire & Fuels Management Mission Statement	Fire Management Goals	Program Objectives	Preparedness Activities	Response to Wildland Fire	Prescribed Fire	Mechanical Reduction	Information/ Education	Monitoring
Our Mission is to use the full range of options and strategies available to manage wildland fire, a process with the power to dramatically alter natural and cultural environments, by: • Protecting park resources, employees and the public from unwanted fire. • Building and maintaining fire resilient ecosystems using the full range of fuel treatment options. • Reducing the threat to local communities from wildfires emanating from the parks or adjacent lands. • Recruiting, training and retaining a professional fire management workforce. • Working cooperatively with all staff to achieve park goals.	*Protect and restore the parks' ecological, cultural, and social values.* Ecological values include vegetation, water, wildlife, natural processes, and air resources. Cultural values include prehistoric and historic cultural sites, historic structures, and contemporary structures, both government-owned and private. Social values include park employees, visitors, neighboring communities, and wilderness. *Reduce fire hazards in park ecosystems.* Fire hazard is defined as those attributes that affect the ability to control fires, or contribute to extreme fire behavior. Fuel conditions can be effectively altered by management actions and are the focus of most fuel hazard reduction activities. *Reduce risk of unwanted wildland fire.* Risk is defined as the probability of new fire starts, whether by human or natural ignitions (lightning). The focus of the risk portion of the fire program is to reduce the probability of unwanted human ignitions.	1. Manage all unplanned wildland fires appropriately.	X	X				
		2. Plan and implement appropriate treatments to reduce the threat to values from unwanted wildland fire and restore or maintain ecological values.	X		X			
		3. Understand the consequences of fire management actions.					X	X
		4. Provide current and accurate information on wildland fire and fuels management activities to the public, our workforce, and cooperating agencies.	X				X	

TARGET CONDITIONS

From the mission, goals, and program objectives above, it is evident that the fire and fuels management program at Sequoia and Kings Canyon National Parks focuses on the restoration and maintenance of natural conditions. But what are some measurable characteristics of natural conditions in the parks?

Since the answer to this question determines the parks' ability to judge success, the parks have been developing specific, measurable benchmarks as a point of reference to determine if the resource conditions resulting from fire management actions are meeting park goals for restoring and maintaining natural conditions.

Target conditions are specific measurable conditions derived from the program objectives listed above. Target conditions answer the question "what would the resource look like if we achieved our goals?"

There are two different types of targets based on existing ecosystem conditions: vegetation structure targets and process targets (Table 2-2). *Structure* refers to elements of vegetation communities that can be described in terms of species present, relative abundance of different species and the arrangement of these elements across the landscape. *Process* refers to the timing of fires, intervals between fires, and the intensity of fires that occurred under natural conditions. In areas of the parks currently in the restoration phase of the program (areas that are significantly altered by past fire suppression), structural targets are used to assess program success. Once these structural targets are met, the area moves into the maintenance phase of the program and process targets are used to evaluate the program goal achievement.

Table 2-2: Relationship between Restoration/Maintenance Phase and Structure/Process Targets

Strategy Based on Existing Resource Condition	Elements of Target Conditions
Restoration Restoring an altered ecosystem to a more natural structure (applied in areas that are significantly altered by past fire suppression)	Structure Targets: Species present Relative abundance of species Arrangement of species Age classes
Maintenance Maintaining dynamically evolving ecosystems in restored or unaltered areas by promoting or simulating the natural process (natural fire regime)	Process Targets: Timing of fires (seasonality) Intervals between fires Intensity of fires under natural conditions Size of fires

Target conditions are very useful to fire managers during both planning and implementation. For example, if the target condition is a stand density of 20-150 trees/ha and the current conditions on the ground have three times that many trees, then fire managers might use prescribed fire to reduce stand density. For all specific target conditions, see the *Fire and Fuels Monitoring Plan* (Appendix C). Once target conditions are identified, appropriate fire management tools are selected and applied to maintain the natural processes that will shape the area into the future.

The parks have developed preliminary target conditions for different vegetation types. They are based on the best available science, including general park information (Chapter 8 – Description of Sequoia and Kings Canyon National Parks) and current fire history data (Chapter 9 – Historic

Role of Fire). This best available science is combined with emerging research data, historic photos, written documents, and expert opinion. It is expected that the target conditions will continue to be refined as future research increases knowledge of past conditions. The target conditions, and the fire and fuels management program as a whole, are constantly evaluated through a comprehensive monitoring program (see Appendix C) and special park analysis tools, like the Fire Return Interval Departure (FRID), discussed in Figure 4-2 in Chapter 4.

The program objectives and target conditions form the basis of Sequoia and Kings Canyon's fire and fuels program. The parks do not arbitrarily set objectives for the number of acres that will be treated with a particular tool (i.e. prescribed fire). Instead, fire managers choose a combination of tools to achieve target conditions. As a result, this fire and fuels program is not defined by the "tools in its toolbox," but rather how restoration and maintenance of natural systems is achieved using these tools.

TOOLS

The key to any successful effort is having access to the right "toolbox." The fire and fuels management program uses the eight tools listed below to accomplish program goals and objectives. These tools are described in detail in Chapter 3.

- Preparedness Activities
- Response to Wildland Fire
- Prescribed Fire
- Mechanical Fuel Reduction
- Public Information and Education
- Monitoring
- Research
- Evaluation

3. Management Toolbox: Implementation Procedures

According to Chapter 2, the goals and objectives of the fire and fuels management program will be accomplished using eight primary tools (restated below). These tools give fire managers a variety of options when choosing the *response to wildland fire* for different situations. As described in the next chapter, these tools are not assigned to particular Zones or Fire Management Units in the parks (see Chapter 4 for a complete description of Zones, Fire Management Units (FMUs) and Segments). Every Zone will allow the full spectrum of responses, however for each Zone and FMU, certain tools may be more ecologically or socially acceptable based upon that Zone's values, hazards, and risks given the time of year.

This chapter defines each tool separately and outlines how it will be implemented. Special emphasis is on the three tools that involve the presence of fire on the landscape. For these tools, there is a description of project planning (if applicable), procedures during and after the fire event, staffing needs/responsibilities, documentation/cost tracking, and special considerations. The long-term strategic planning and review process is covered in Chapter 4.

The Management Toolbox Includes:

- Preparedness Activities
- Response to Wildland Fire
- Prescribed Fire
- Mechanical Fuel Reduction
- Public Information and Education
- Monitoring
- Research
- Evaluation

TOOL #1 – PREPAREDNESS ACTIVITIES

Definition

Preparedness includes all preplanned actions that lead to effective prevention of unwanted fires and the appropriate response to all fire ignitions. The parks work hard to "sharpen" their preparedness activities since many other tools in the toolbox depend on training, fire prevention, fire readiness, etc. Some preparedness actions happen once each year, while others are ongoing.

Base Level Staffing

All park operations modules will operate as "modules" only when they meet national standards for crew module configuration. In other words, a Type 3 engine will only operate as a Type 3 engine when it is staffed by an engine boss plus two firefighters. Such standards will exist for engines, helitack, and fuels crews. Engine and helitack configurations will follow the standards outlined in the Interagency Standards for Fire and Fire Aviation Operations. In the absence of national standards, park fuels crews will follow park staffing guidelines.

Each of the two districts, Sequoia and Kings Canyon, are staffed by the district FMO or acting district FMO each day of fire season. Similarly, the park FMO will designate an acting park FMO when they not available. The fire and aviation communications center will be staffed with at least one person during the burning period for all days during fire season. Each District FMO will assign a duty officer or will serve as duty officer for each day the parks are in Staffing Level III or higher.

Training

Employee training records and wildland fire training activities, including IQCS entries, will be coordinated and maintained by a designated wildland fire training officer. Ordinarily, these duties will be assigned to the supervisory wildland fire logistics dispatcher. However, based upon workload and need, the parks Fire Management Officer may choose another member of the wildland fire staff to assume these responsibilities.

The parks will offer the required annual safety training for all wildland firefighters who maintain a red card. At minimum, annual training will consist of an 8-hour firefighter safety refresher that must include training on fire shelter care and use. Basic firefighter training (inclusive of S-130/190) will be provided for all employees new to wildland fire who hold arduous duty positions. Since there are also experience and training requirements needed for all designated wildland and prescribed fire positions, the parks will offer a variety of ICS and skills-based training classes or send employees off-park to receive required training. Qualifications for all positions will conform to minimum standards established in the *Wildland and Prescribed Fire Qualifications System* publication PMS-310-1. More stringent qualifications may be imposed by the department, agency, or park as needed.

Training needs are determined by the parks Red Card Committee, composed of the park fire management officer, both district fire management officers, the park fuels specialist, the Arrowhead Hotshot superintendent, and wildland fire training officer. The current qualification levels of employees are compared to the parks' minimum qualifications list (see Appendix R). The comparison allows the committee to develop a list of training needs. The wildland fire training officer takes this list to the regional training officers meeting to obtain slots in training courses for park employees. The parks' Fire Management Officer is responsible for reviewing and approving wildland fire qualifications below the Type 2 Command and General Staff level.

Fitness

All wildland fire staff involved in firefighting will pass an annual physical fitness test and receive a physical exam as required by national guidance. Fire personnel, who are identified as primary firefighters, will also participate in an ongoing fitness program. The annual fitness test has potential for firefighter injury. Therefore implementation of the test will follow all required procedures and safeguards. The current SOPs for the fitness test can be found in the JHA for the Pack Test. Physical fitness programs will follow guidelines found in RM-18 and the Interagency Standards for Fire and Fire Aviation Operations.

Fire Prevention

Fire prevention is an important aspect of the parks' preparedness activities. The parks will conduct an active fire prevention program including public messages, inspections, fire restrictions, and hazard abatement reduction around structures. This program is fully detailed in the *Wildfire Prevention Plan* (Addendum).

Additional prevention activities for the parks will consist of prevention signing, prevention messages through interpreters and staff, and prevention patrols during periods of very high to extreme fire danger. A comprehensive public information and education program is detailed in this chapter, Tool #6. In addition, fire use restrictions and area closures may be necessary. Details can be found in the *Fire Restrictions and Emergency Closure Plan* (Appendix M).

Fire Readiness

Fire readiness is the year-round organized inventory and assessment of equipment and personnel. The parks have developed a summary list of all preparedness activities by month. This comprehensive calendar of preparedness activities is located in the Yearly Readiness Checklist (Appendix S). As part of the readiness program all operations modules and support personnel will be assessed annually through a readiness review and inspection program. Also, mandatory pre- and post-season operations preparedness and review meetings are held each spring and fall.

Weather

The parks have six weather stations that provide daily information. All six stations are Remote Automated Weather Stations (RAWS). While all 6 stations catalogue fire weather either hourly or daily, only 3 stations are used for the parks National Fire Danger Rating System (NFDRS) indices calculations. These stations are located at Cedar Grove, Park Ridge, and Ash Mountain. These three NFDRS stations will be monitored daily throughout fire season.

Stations are located at:

- Ash Mountain – NFDRS models B, F, A [elevation 1,600 feet]
- Park Ridge – NFDRS models G, H, U [elevation 7,540 feet]
- Cedar Grove – NFDRS models U, G [elevation 4,720 feet]
- Wolverton Point – NFDRS models B, F [elevation 5,240 feet]
- Sugarloaf – NFDRS models H, U [elevation7, 950 feet]
- Rattlesnake – NFDRS models H, U [elevation 8,600 feet]

Fire Danger Determination

The parks' fire dispatch office tracks NFDRS fire danger indices and plots them against historical averages. The Energy Release Component (ERC), determined using Model G from the Park Ridge station, assesses fuel conditions in median elevations throughout the parks. The Burning Index (BI), determined using Model B from the Ash Mountain station and Model U from the Cedar Grove station, is used to index suppression response to ignitions at lower elevations. Critical fire danger conditions are reassessed annually using FireFamily+. "Pocket Cards" detailing these conditions are subsequently issued to all wildland fire modules as part of the spring readiness and training program.

The parks will not automatically extinguish natural ignitions based upon Park Ridge ERC values in the very high or extreme category. The combination of values, hazards, and risks as identified for each FMU will determine wildland fire response. While use of wildland fire is not restricted due to fire danger rating classification (very high or extreme indices), prescribed fire ignitions may be restricted.

Step-Up Staffing Plan (Appendix O)

After daily fire weather is processed and existing and forecast fire danger conditions are determined, the park will implement preparedness staffing as appropriate. The parks' *Preparedness Staffing Plan* insures that adequate fire staff is on duty for periods of high fire danger. The plan, found in Appendix O, sets guidelines to increase or decrease daily hours worked, numbers of people on duty, etc. The plan also provides a list of tasks to accomplish as fire danger rises.

The parks' daily staffing levels are determined by the park-wide fire danger indices derived by combining ERC from the Park Ridge station with BI values from the Ash Mountain and Cedar Grove stations. A complete description of the process used to ascertain the park-wide fire danger and the staffing logic can be found in the *Preparedness Staffing Plan* (Appendix O). The Preparedness Staffing Plan will be reviewed annually to assure that weather data used to calculate indices is reflective of the current situation and that fiscal controls and policy requirements governing the use of Step-Up Staffing accounts are being met.

In general the plan calls for the following staffing:

- Staffing Levels 1, 2, and 3: normal tours of duty and number of fire personnel.
- Staffing Level 4 and 5: the fire management officer (FMO) or his acting may authorize extended hours and increased staffing for fire crews. The program assistant will follow annual budget fire business rules to establish an appropriate account to cover expenditures.

Suppression Fire Response Plan

A *Suppression Fire Response Plan* has been developed for use by the parks and its cooperators (Cal Fire – Tulare and Fresno/Kings Units, Sequoia National Forest, and Sierra National Forest). The plan characterizes response for those lands in each of the agencies' jurisdictional areas for which shared response is beneficial. The plan is reviewed annually and undergoes thorough revision every five years. Response levels vary based upon daily fire danger staffing level determinations and initial fire size-up.

Emergency Response Driving Guidelines

Wildland fire suppression response at Sequoia and Kings Canyon National Parks is seldom an emergency requiring an emergency response. Lights and sirens will not be used when responding to wildfire incidents in or out of the parks. Vehicle operators, regardless of the vehicles size or equipment, may not exceed the posted speed limit and must obey all traffic rules and regulations either in or out of the park.

Overhead or other flashing or rotating lights should be illuminated on properly equipped wildland fire vehicles when visibility is diminished during wildfire incidents, prescribed fire incidents, or other low visibility circumstances that require the vehicle to be stationary or moving slowly along the side of the highway or is blocking or impeding traffic. This would include all traffic control duties.

It is recognized that there may be rare exigent circumstances in which human life and safety is directly threatened and for which an emergency response could prevent serious injury or death. The duty officer may authorize wildland fire engine operators who have completed the NFPA approved NPS Structural Fire Apparatus Operators course to briefly use lights and siren on either Type 3 or Type 6 engines to clear traffic in order to expedite the response. Such response must follow the guidelines found in Chapter 3 of the Interagency Standards for Fire and Fire Aviation Operations. The duty officer will document the circumstances necessitating this response on the incident log in Park Dispatch. The Fire Management Officer will investigate the incident and prepare a written report that to be reviewed by the Chief Ranger and/or Park Superintendent.

TOOL #2 – RESPONSE TO WILDLAND FIRE

Response to wildland fire is the mobilization of the necessary services and responders to a fire based on ecological, social, and legal consequences, the circumstances under which a fire occurs, and the likely consequences on firefighter and public safety and welfare, natural and cultural resources, and values to be protected.

All wildland fires in the parks may be concurrently managed for one or more objectives and objectives can change as the fire spreads across the landscape (over space and time). Objectives are affected by changes in fuels, weather, topography; varying social understanding and tolerance; and involvement of other governmental jurisdictions having different missions and objectives.

Firefighter and public safety is the first priority in every fire management activity and will be included as the primary objective for all wildland fire incidents. Sound risk management is a foundation for all fire management activities. Risks and uncertainties relating to fire management activities must be understood, analyzed, communicated, and managed as they relate to the cost of either doing or not doing an activity. Net gains to the public benefit will be an important component of decisions.

For example, a fire that poses unacceptable risks to firefighter safety during a direct suppression response may be managed under confine/contain strategies to address firefighter safety regardless of fire size. Conversely, a fire may be suppressed at the smallest size to limit risks to firefighters, to limit smoke production for public health, or because natural or cultural resources are threatened. However, in all cases, the long-term ecological benefits of fire on the Sierra Nevada must also be considered

Fire managers may choose from a wide array of objectives, strategies, and tactics that range from monitoring to aggressive suppression actions providing that the response is consistent with federal policies and laws (i.e., the National Fire Plan, the Wilderness Act) and park level plans and policy (i.e., the Fire and Fuels Management Plan, the parks' Wilderness Stewardship Plan). When viable (after considering values, hazards, and risks), these parks will utilize unplanned lightning fires as the preferred means to accomplish specific resource management objectives in the Zones and FMUs where restoration and ecological values dominate considerations. If unnatural fuel loads exist, it may be necessary to use other fuel management techniques initially to restore an area to a natural range of conditions before using fire as a tool. Utilization of natural ignitions to restore and maintain natural fire regimes was formerly referred to as wildland fire use or simply fire use. Changes in national fire policy in 2008/2009 eliminated this term. Instead, use of wildland fire is the chosen response when objectives are based on ecosystem restoration and maintenance where wildfire is the primary tool.

A course of action based on the parks' strategic fire management objectives, incident specific objectives, and management requirements will be developed for all wildfires. Preplanned initial actions for each fire management zone serve as the default course of action and will be identified in the parks' response plan and updated annually. The response plan lists the maximum number of resources at a given threat level that would expected to be needed to implement a course of action necessary to meet the objectives and protect the resource values for each Fire Management Unit identified in Chapter 4 of this plan. If the initial actions in the response plan fail to meet the objectives and management requirements for that fire management unit or zone, then a new specific course of action based on the strategic and incident objectives and management requirements will be developed. The process outlining management of an unplanned ignition is found in Appendix B of the 2009 *Guidance for Implementation of Federal Wildland Fire Management Policy* (Addendum).

The *response to wildland fire* ranges from monitoring with minimal on-the-ground disturbance to intense suppression actions on some or all perimeters of the fire. The response will vary from fire to fire and even along the perimeter of a fire in order to meet incident specific objectives.

The Wildland Fire Decision Support System (WFDSS) will be used to document all unplanned wildland fire ignitions in the park and document any course of action beyond the preplanned response. WFDSS provides a framework for assessing preplanned response, data gathering and situation analysis (i.e. firefighter and public safety, internal and external values which are enhanced or require protection, management objectives, safety, climatology and weather, fuel conditions, and fire behavior) consistent with the parks' land/ resource management plans and the Fire Management Plan.

The NWCG approved Relative Risk Assessment, will be used to identify relative risks for wildfire incidents. The NWCG approved Organizational Needs Assessment along with the Incident Complexity Analysis (*Interagency Standards for Fire and Fire Aviation Operations* Appendix E and F) will be used to guide the superintendent's decision in determining the appropriate level of management for a wildfire incident.

WFDSS will be used to document the Relative Risk Rating, organizational level, selected course of action, and projected costs. If the management complexity of the fire exceeds the capabilities of local resources, the parks will manage the incident through delegation to an Incident Management Team (see Appendix K for a delegation of authority example).

All wildland fires will be assigned a qualified incident commander with the appropriate skills given the incident's complexity before any tactical operation is initiated.

Staffing Needs and Responsibilities

Duty officers for each district will be assigned every day during fire season; ensuring appropriate, qualified command staff is available. An on-call Resource Advisor (READ) is also assigned during fire season to advise fire management staff of resource management issues and to coordinate resource management concerns in determining the appropriate response. Additional park staff serving as subject matter experts will be involved in planning as conditions, issues, and fire location dictate. Examples include: district rangers, archeologist, wildlife biologist, roads and trails supervisor, district facility manager, and the fire information and education specialist.

When the park wide Staffing Level is 3 or higher, firefighters assigned initial action responsibilities will be expected to initiate response in 5-minute or less. All modules will be equipped so that they can leave directly from a project site, prepared for an unsupported 24-hour assignment, without having to return to the station. Additional Step-up Staffing direction to meet increased fire danger conditions are specified in Appendix P. Work/rest guidelines will not be violated.

Unplanned fire is reported: What do we do?

When a wildfire is reported, the parks will take the following actions:

- Locate the fire
- Notify the appropriate duty officer

The duty officer will strategically assess the fire, determine cause, determine initial incident strategy and objectives, establish the appropriate level of incident command, and oversee the preplanned response identified in the parks' Response Plan. The parks' Response Plan will be used to identify the range of resources available for initial actions to all wildland fires. The response plan is designed to consider values to be protected, risks, hazards, forecasted fire danger, and ecological benefit.

If the fire is determined to be a human caused ignition: Initial action on human caused fire will be to suppress the fire at the lowest cost with the fewest negative consequences with respect to firefighter and public safety. Confine/contain/control strategies will be considered.

If the fire is determined to be a natural ignition: Initial actions for natural ignitions will be determined based upon potential complexity, climatology and projected fire behavior, and natural and cultural resource effects. Initial actions may range from monitoring to aggressive suppression action, but must be consistent with the guidance provided in Chapter 4 of this plan.

Extended Response Fires

If the initial actions are unsuccessful for more than one operational period or additional resources beyond those identified in the Response Plan are needed then the District FMO will notify the Parks FMO that a new course of action is needed. The parks' FMO is responsible for designating a team with the appropriate level of expertise necessary to analyze the situation, identify values to be protected and values to be enhanced, and evaluate risk. This team will complete a new WFDSS document with a new recommended course of action for the Park Superintendent's review and approval. Timelines for developing new courses of action and for completing WFDSS decision documents are outlined in Chapter 11 of the Standards for Interagency Fire and Fire Aviation Operations.

The Parks' Fire Management Officer may tentatively approve the Course of Action beyond that in the Response Plan for instances where timeliness would be critical to the success of the operation. However, the FMO should brief the superintendent as soon a practically possible and obtain, at a minimum, verbal approval to continue the course of action.

NPS regional staff should be consulted in the development of the selected course of action during national preparedness level 4/5. NPS national staff should be consulted in the development of the selected course of action during national preparedness level 5.

The parks will cooperate with state or federal air quality guidelines for tracking particulate matter emissions from fires and to assist with the notification of affected communities if necessary (based upon the EPA air quality index (AQI) standards).The San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) will be notified of all ignitions per the standards and guidelines established in the SJVUAPCD work plan. The parks will monitor daily PM-2.5 values at Ash Mountain air quality base station and install portable air quality monitoring stations at smoke sensitive sites affected by fires whenever practicable or possible.

The parks will notify the public about the chosen management response. Use contact lists and communication methods from *Standard Operating Procedures: Fire and Fuels Information* (Addendum). In addition to regular information about project logistics, location, and objectives, use appropriate smoke information and recommendations (see smoke talking points in the *Smoke Communication Strategy*, Appendix I).

The course of action will be continued until the fire is declared out or strategic objectives, incident objectives or management requirements are not being achieved. Under the latter circumstances, a new course of action will be developed, approved, and implemented. The rationale for the new course of action will be documented using the WFDSS process.

Cost Containment - All selected courses of action will consider cost containment efforts while also weighing potential risks and benefits. The lowest cost option may not always be the preferred alternative if long-term, cost-effective benefits can be achieved under the selected course of action. Regional director approval is required if the cost for the selected course of action is expected to exceed $5,000,000.00. NPS Director approval is required is the cost for the selected course of action is expected to exceed $10,000,000.00.

Approval and Validation Processes and Procedures

The superintendent must validate that the fire is managed appropriately and will assess if there is a need to change objectives, strategies, or tactics. The superintendent will be notified of all wildfires within 24 hours of ignition and briefed on all active wildfires within the park at least once every 14 days. At their discretion, the superintendent may require a shorter re-validation period. Documentation of this briefing and the superintendent's approval of the course of action will be maintained in park dispatch and, as appropriate, electronically in the WFDSS document.

Post-fire: What do we do?

Rehabilitation will follow the parks' Minimum Impact Suppression Tactic (MIST) Guidelines as outlined in the parks if on-the-ground actions are taken to check fire spread. In the event a fire covers large areas, has unnaturally severe effects on natural or cultural resources, or causes major impacts to the parks developed resources (i.e. trail system) a separate *Burned Area Emergency Rehabilitation Plan* or *Burned Area Rehabilitation Plan* will be developed by the Resources Management and Science and Fire Management Offices, and approved by the superintendent. Regional or national teams will be called if needed.

Assemble monitoring data as part of the final fire package.

Review incident when deemed appropriate by fire management staff, superintendent, or fire management committee.

Documentation and Cost Tracking

The fire folder will contain copies of all documents as outlined in Appendix P (Wildland and Fuels Management Reporting Requirements). The folder will include: all planning documents (WFDSS and amendments), delegations of authority, monitoring data and summary reports, revalidation and certification documents, fire time reports, maps, photos, and DOI-1202). All expenditures (personnel, aircraft, supplies, and equipment) will be tracked and reported according to the standards established in the Department of the Interior Individual Fire Occurrence Form (DOI-1202). All fire projects will have an appropriate fire management accounting code.

It will be the responsibility of the district fire management officer, or his/her incident commander on the fire to ensure fire report completion. The report is a valuable tool as it provides an historical record of the fire regime for the parks. The DI-1202 is the basic document used by the National Interagency Fire Center (NIFC) to document a fire occurrence.

Special Considerations

The RAWS station at Park Ridge will be utilized for tracking ERC values for fires because of the long history of quality weather data collected at this upper elevation site. This data can be used in programmatic and individual fire analyses of climatological data (i.e. FireFamily+) for fire planning Additional RAWS units in the Sugarloaf drainage, Rattlesnake Creek in the Kern drainage, at Ash Mountain, and at Wolverton Point in the East Fork Kaweah drainage are also available for aiding operational decision making.

TOOL #3 – PRESCRIBED FIRE

Prescribed fires are ignited by management to achieve resource objectives, most often a combination of ecosystem restoration or maintenance objectives and reduction of high hazard fuel loadings. These objectives are not mutually exclusive and usually all prescribed fire operations contain a mix of them. In certain areas of the parks where lightning-caused fires continue to be suppressed, prescribed fire may be used to replace these suppressed natural ignitions.

Prescribed fires must be described in a prescribed fire burn plan. The plan will contain a prescription defining objectives and treatment methods employed to achieve the objectives (see Appendix N for prescribed fire plan template). Fuels management prescriptions are detailed in Appendix E.

Prescribed fire may also be used in concert with mechanical treatment. High hazard fuel conditions can be reduced while meeting structural objectives in areas immediately adjacent to infrastructure values or in boundary areas through a mix of mechanical treatment and prescribed fire. Mechanical treatment can be used as the primary method of reaching structural goals while prescribed fire actually removes the hazardous fuels.

Examples:

There is a hazardous accumulation of fuels adjacent to infrastructure values that can be mitigated with the use of prescribed fire. The main objective of the burn operation would be reducing high hazard fuels with ecosystem restoration as a secondary consideration.

There is a drainage that requires restoration of the ecological fire process. There are no infrastructure values or boundary issues. The main objective of the burn would be restoration of ecological processes. The secondary objective would be reducing high hazard fuels.

There is a drainage that has been prescribed burned for ecosystem restoration. For a variety of reasons, several constraints have precluded taking advantage of natural ignitions for ecosystem maintenance. The drainage has missed one or two fire return intervals and is showing signs of high hazard fuels build-up, species composition shift, and increased stand density. The main objective of the burn would be for ecosystem maintenance purposes.

Maintenance or restoration prescribed fires in sequoia groves to promote new generations of the parks' icon species. Giant sequoias are fire adapted and thrive in naturally cycling fire. Fire opens the cones, and releases the tiny seeds to the nutrient rich ash and mineral soil below—ideal conditions for this tree's germination. Fire thins competing vegetation and trees and opens the canopy for this sun-loving species, which allows for these young trees to become established and grow.

Planned Treatment - Prescribed Fire: What do we do?

Annually update parks geographic information system (GIS) data according to fuels management accomplishments from the previous year and re-run fuels analysis.

Annually identify areas that need prescribed fire and/or mechanical treatments by evaluating values, hazards, and risks for the three Zones and nine FMUs. The parks GIS is the primary data storage and analysis system employed to achieve this goal. Where appropriate, treatment across agency boundaries is encouraged and facilitated. This work is an outgrowth of efforts to develop GIS data layers by watershed boundaries across agency jurisdictional boundaries.

Select treatment priorities based upon the analysis of the values, hazards, and risks. Consider managerial capabilities to accomplish treatments given practical limitations in planning, finance, and logistical support. Park prescribed fire targets may be adjusted to plan for no more than two prescribed fire projects per year per fire management unit, while also attempting to limit project duration to no more than 14 days per burn to mitigate smoke impacts to the FMU. In addition, use of wildland fire or suppression fires which burn park acreage (over 100 acres) in a fire management unit will factor into the decision to implement planned prescribed fire ignitions in the same fire management unit that year. It must be recognized due to unnatural fuel build-up, that it may be necessary to burn more than two prescribed fire projects in a given FMU in a particular year. These may be rare occurrences in FMUs which are far behind treatment targets and/or in order to take advantage of exceptional burn windows.

Write the annual fuels treatment plan that describes the program for the up-coming field season including descriptions of individual segment preparation and execution needs. Share with the District Management Teams. Insert this annual plan into a revised *5-Year Fuels Treatment Plan*. This document is completed each spring following consultation with and fire management committee review and concurrence.

Register the annual *Fuels Treatment Plan* with the Air District. Note that air quality regulations and requirements are dynamic and subject to change. The process described below is in effect at the time of this document's publication. Updated procedures and requirements enacted after the approval date of this plan will be incorporated in annual updates to the *Fire and Fuels Management Plan*. While the District does not have authority to approve or reject this overall *Fuels Management Plan*, it does approve the smoke management plans for individual prescribed burns which are submitted via the Prescribed Fire Information Reporting System (PFIRS). The District no longer requires submission of the actual prescribed fire burn plans. Air quality concerns remain the major issue affecting prescribed fire treatment.

Assign burn bosses to individual treatment segments. Each burn boss scouts the area and works with the Fire GIS Specialist to create preliminary maps of the unit.

Scope park subject-matter experts. Each burn boss consults with park subject-matter experts prior to writing the project plan. Subject-matter experts are usually comprised of the parks Inter-Disciplinary Team members as designated by the parks Environmental Management Committee.

Scoping for prescribed fire projects is completed through subject matter experts and with significant findings documented in Planning Environment and Public Comment (PEPC) program. Fire management staff uses PEPC to document their mitigation actions to these significant findings.

Complete the parks Minimum Requirement Analysis (MRA) to identify the minimum tools and the least impact required to complete the project if any portion of the burn segment falls within designated wilderness. The use of mechanized equipment in wilderness (including chainsaws and helicopters) must be justified and pre-approved by park management in non-emergency incidents. After completion, individual MRAs are attached to the burn plan (completed by the burn boss and signed by the Superintendent).

Strive to complete burn plans by May 1 each year giving the park fire management staff, chief ranger, and superintendent adequate time to address any remaining issues associated with the planned prescribed fire.

Begin field work to prepare for projects.

Submit a smoke management plan via the Prescribed Fire Information Reporting System (PFIRS) for Air District approval a minimum seven days in advance of ignition.

Request Pre-Ignition Forecasting. No more than seven days prior to the earliest ignition date, a Planned Ignition Forecast Advisory (PIFA) will be submitted to the Air District to begin long-range smoke dispersal forecasting for the proposed ignition. The District will provide 96, 72, 48-hour outlooks, and 24-hour forecasts on days leading up to the proposed ignition date. The District retains final go/no-go authority until the time of ignition.

Notify the public about the annual project list. At the beginning of fire season, notify local communities, media, businesses, agency partners, and employees about upcoming projects for the year.

Project Implementation: What do we do?

Notify the public about the upcoming ignition. Use contact lists and communication methods from *Standard Operating Procedures: Fire and Fuels Information* (Addendum). In addition to regular information about project logistics, location, and objectives, use appropriate smoke information and recommendations (see smoke talking points in the *Smoke Communication Strategy*, Appendix I).

Monitor weather and fuels against prescriptive criteria. Prescribed burns are ignited when weather conditions are favorable for dispersing smoke away from Smoke Sensitive Areas (SSAs), or during conditions that dilute smoke so that impacts to SSAs do not exceed health standards. This will be accomplished by utilizing the most current and comprehensive weather forecasting information available for predicting smoke transport direction and concentration down wind.

Fuel moisture is also a high priority prescription element that will be monitored pre-burn. Fuel moisture prescriptions are designed to provide the optimum balance between the need to moderate fire behavior, minimize undesired fire effects on other resource values, and minimize smoke production (drier fuels burn cleaner and produce less pollutants). Fuel moisture information will be obtained and analyzed pre-burn, primarily focusing on live and dead 1000-hour fuels. One hour fuel moistures will be measured throughout ignition to ensure conformity with the prescription.

Assess potential of other park fire management workload on successful outcome for the burn. Consider the cumulative air quality effects of the upcoming project and any wildland fires that may already be burning in the parks. Fire Program managers will determine the correct course of action that considers safety, air quality, available resources, and the ecological health of the parks forest. This may include postponing the burn, conducting holding actions on a wildfire to complete the burn, or any other range of options that best address parks overall management and health.

In the days prior to a burn:

- Obtain superintendent go/no go decision on ignition.
- Seek concurrence from the Air District to proceed with ignition.

The day of the burn:

- Hold briefing and review burn plan operations with burn staff.
- Ignite a test-fire.
- Make final go/no go decision on ignition (burn boss and associates).
- Provide interpretative information if adjacent to visitor-use area.
- If the fire exceeds prescription criteria, notify the superintendent of the escape and initiate a Wildland Fire Decision Support System (WFDSS).

Post-fire: What do we do?

- Report daily acres and emissions to the Air District.
- Rehabilitation will follow Minimum Impact Suppression Techniques (MIST) as outlined in the parks' Fire and Aviation Management Operations Guide (Addendum). Assemble monitoring data as part of the final fire package.
- Survey the burn perimeter and roadways for hazard trees. Report to the Park Forester trees that are unable to be mitigated.
- Review incident when deemed appropriate by fire management staff, superintendent, or fire management committee.
- Report final fuel treatment accomplishments for the project to the National Fire Plan Operations and Reporting System (NFPORS).
- Prepare all reports as required.

Staffing Needs and Responsibilities

The park fuels management specialist in conjunction with the district fire management officers is responsible for the implementation of the annual fuels treatment program within their respective areas. A team comprised of district fire management officers, the park fuels specialist, fire ecologist, fire communication and education specialist, and the fire GIS specialist will meet to compose the development of the annual program and associated *5-Year Fuels Treatment Plan*.

District fire management officers will take the lead for each of their districts. The park fuels specialist is responsible for consolidating both district FMOs treatment requests into one coherent park-wide plan. The fuels specialist has final say over the district FMOs regarding treatment priority determination between the districts. The park fuels specialist in conjunction with the district fire management officers is responsible for prescribed burn plan completion.

Each burn will be staffed by an agency-certified burn boss (appropriate to the level required), as well as other staff necessary to conduct the operation safely and efficiently. Individual burn plans will comply with requirements described in the Interagency Prescribed Fire Planning and Implementation Procedures Guide as well as RM-18. Prescribed fire burning prescriptions can be found in Appendix E.

Individual prescribed fire operations can last from one day to several months. Close coordination and strong communication is required between operational overhead, the fire information and education specialist, fire effects and research program staff, general park staff, local air quality control district staff, and dispatchers.

All fire management activities in the parks will rely on tactics that minimize resource damage while maintaining the safety of the public, firefighters, and other personnel. Tactical tools used in Wilderness will be chosen carefully. In cooperation with the Wilderness Management Program, burn bosses will complete a minimum requirement analysis (MRA) for all projects in Wilderness requiring mechanized equipment and attach to the burn plan (stated above).

If needed, a post-burn hazard tree removal (for second-order hazard trees) request will be submitted by the Division of Resources Management and Science to the parks fuels specialist. While funding is generally not available, fire management may be able to provide assistance with hazard tree mitigation directly caused by a particular prescribed burn. The parks will ensure that all such requests meet the approved parks Hazard Tree Plan.

Documentation and Cost Tracking

The fire folder will contain copies of all documents as outlined in Appendix P (Wildland and Fuels Management Reporting Requirements). The folder will include: all planning documents (burn plan and any amendments, smoke permit, incident action plans), monitoring data and summary reports, fire time reports, maps, photos, and NPS Wildland Fire Report Form. All expenditures (personnel, aircraft, supplies, and equipment) will be tracked and reported according to the standards established in the NPS Wildland Fire Report Form. All prescribed fires will have an appropriate accounting code.

The park fuels specialist will be responsible for reporting all prescribed burn accomplishments into the National Fire Plan Operations and Reporting System.

It will be the responsibility of the district fire management officer, or his/her burn boss on the fire to ensure fire report completion. The report is a valuable tool as it provides an historical record of the fire regime for the parks. The NPS Wildland Fire Report Form is the basic document used by the National Interagency Fire Center (NIFC) to document a fire occurrence. The park fire dispatcher is responsible for entering all NPS Wildland Fire Report Forms into the Wildland Fire Management Information (WFMI) system.

Special Considerations

Climatological weather data analysis is used to assess the probability of season ending weather events as an aid in prescribed fire planning. It is especially important to determine ignition timing for landscape scale burns with minimal control lines. The closest weather station at a similar elevation often serves as the representative record.

TOOL #4– MECHANICAL FUEL REDUCTION

Mechanical fuel reduction is the use of mechanical equipment (i.e. weed whackers, chainsaws, dozers, rubber tired skidders, chippers, etc.) to cut and remove, or prepare for burning, woody fuels. Mechanical treatments are intended to help in achieving resource management objectives, most often a combination of ecosystem restoration and reduction of high hazard fuel loading objectives. Mechanical treatments must be described in a mechanical treatment plan. The plan will contain a prescription defining objectives and treatment methods employed to achieve the objectives (see Appendix N for mechanical plan template). Fuels management prescriptions are detailed in Appendix E. Extensive mechanical treatment, outside the bounds of the companion *Environmental Assessment*, would require further environmental analysis.

Mechanical treatment may be used in concert with prescribed fire treatment. High hazard fuel conditions can be reduced while meeting structural objectives in areas immediately adjacent to infrastructure values or in boundary areas through a mix of mechanical treatment and prescribed fire. Mechanical treatment can be used as the primary method of reaching structural goals while prescribed fire actually removes the hazardous fuels.

Examples:

Prescribed fire has been used extensively to reduce fuels and restore natural conditions in a large area uphill from a development. However, the fuels complex immediately adjacent to the structures presents significant prescribed fire control problems and the only practical method for reducing the hazardous fuels adjacent to the structures may be through the use of mechanical techniques and then prescribed burning the slash pile accumulations.

Heavy fuels immediately adjacent to structures, if burned, would cause an unacceptable amount of large trees to be injured or killed resulting in an increase in hazard trees. Mechanical treatment is used before prescribed burning in order to reduce the potential of the burn causing future hazard trees.

Planned Treatment – Mechanical Treatment: What do we do?

Annually update parks geographic information system (GIS) data according to fuels management accomplishments from the previous year and re-run fuels analysis.

Annually identify areas that need prescribed fire and/or mechanical treatments by evaluating values, hazards, and risks for the three Zones and nine FMUs. The parks GIS is the primary data storage and analysis system employed to achieve this goal. Where appropriate, treatment across agency boundaries is encouraged and facilitated. This work is an outgrowth of efforts to develop GIS data layers by watershed boundaries across agency jurisdictional boundaries.

Select treatment priorities based upon the analysis of the values, hazards, and risks. Consider managerial capabilities to accomplish treatments given any limitations in planning, finance, and logistical support.

Write the annual fuels treatment plan that describes the program for the up-coming field season including descriptions of individual segment preparation and execution needs. This information will be shared with the District Management Teams. Insert this annual plan into a revised *5-Year*

Fuels Treatment Plan. This document is completed each spring following consultation with and fire management committee review and concurrence.

Assign project leaders to individual treatment segments. Project leaders scout the area and work with the Fire GIS Specialist to create preliminary maps of the unit. All NPS owned structures will be protected to a reasonable extent from unplanned fire events by the clearance of hazardous fuels on an annual basis. This hazard abatement work will comply with California Public Resource Code (PRC) 4290. Work will be performed by a combination of park fire crews, park residents, and maintenance grounds keeping crews. In areas where the NPS has jurisdiction over park concessionaires and private property in-holdings, the NPS will require building owners or leasers to comply with PRC 4290.

Scope park subject-matter experts. Each project leader consults with park subject-matter experts prior to writing the project plan. Subject matter experts are usually comprised of the parks Inter-Disciplinary Team members as designated by the parks Environmental Management Committee.

Scoping for mechanical projects is completed through subject matter expert and with significant findings documented in Planning Environment and Public Comment (PEPC) program. Fire management staff uses PEPC to document their mitigation actions to these significant findings.

Complete the parks Minimum Requirement Analysis (MRA) to identify the minimum tools and the least impact required for mechanical thinning projects within the Wilderness. The MRA may indicate that a further Environmental Assessment needs to be completed for the project.

Strive to complete mechanical treatment plans by May 1 each year giving the park fire management staff, chief ranger, and superintendent adequate time to address any remaining issues associated with the proposed treatment.

Notify the public about the annual project list. At the beginning of fire season, notify local communities, media, businesses, agency partners, and employees about upcoming projects for the year.

Project Implementation: What do we do?

- Notify the public about the upcoming mechanical project. Use contact lists and communication methods from Standard Operating Procedures: Fire and Fuels Information (Addendum).
- Assess effects of other park fire management workload on successful outcome for the project.
- Notify the public about the planned treatment.
- Hold briefing and review treatment objectives and operations with treatment staff.
- Begin implementing project. All projects involving treatment of fuels adjacent to structures must comply with California Public Resource Code 4290.
- Provide interpretive information if adjacent to visitor-use area.
- Per Management Directive #11, the park superintendent has the authority to destroy downed wood resulting from mechanical fuels reduction activities. Fuels resulting from mechanical treatment activities will be lopped and scattered or piled and burned.

Post-Project: What do we do?

- Rehabilitation will follow Minimum Impact Suppression Techniques (MIST) as outlined in the parks Fire and Aviation Management Operations Guide (Addendum). Rehabilitation will be accomplished by the end of the following field season.
- Assemble monitoring data as part of the final project package.
- Review incident when deemed appropriate by fire management staff, superintendent, or fire management committee.
- Report final fuel treatment accomplishments for the project to the National Fire Plan Operations and Reporting System (NFPORS).

Staffing Needs and Responsibilities

The park fuels management specialist in conjunction with the district fire management officers is responsible for the implementation of the mechanical treatment program within their respective areas. They work together on the development of the annual program and *5-Year Fuels Treatment Plan*.

The park fuels specialist is responsible for consolidating both district FMOs treatment requests into one coherent park-wide plan. The fuels specialist has final say over the district FMOs regarding treatment priority determination between the districts. Mechanical hazard fuels abatement standards can be found in Appendix E.

All fire management activities in the parks will rely on tactics that minimize resource damage while maintaining the safety of the public, firefighters, and other personnel.

Documentation and Cost Tracking

The project folder will contain copies of all documents as outlined in Appendix P (Wildland and Fuels Management Reporting Requirements). The folder will include: all planning documents (treatment plan and any amendments, incident action plans), monitoring data and summary reports, personnel time reports, maps, photos, and fuels accomplishment summary reports. All expenditures (personnel, aircraft, supplies, and equipment) will be tracked and reported according to the standards established in the NPS Wildland Fire Report Forms). All projects will have an appropriate accounting code.

It will be the responsibility of the district fire management officer, or his/her project leader to ensure treatment report completion. The report is a valuable tool as it provides an historical record of the fuels treatment history for the parks. At this time NPS Wildland Fire Report Forms cannot be completed for mechanical treatments. They are only completed for projects involving fire occurrence.

The park fuels specialist will be responsible for reporting all mechanical accomplishments into the National Fire Plan Operations and Reporting System.

Special Considerations

Slash fuels that are derived from mechanical treatments and hazard tree removal operations can be burned for disposal purposes. Slash piles that are on NPS lands will be burned by NPS supervised fire personnel and adhere to prescribed fire guidelines whenever the burning is classified by fire management staff as a prescribed fire. Slash piles on private lands will be burned by the property owners, or their agents, through a permit process. Property owners need to submit the form, "Permit for Burning Slash Piles" (Appendix M), through respective district fire management officers for approval by the park superintendent.

District fire management officers are responsible for the coordination of burning slash piles on NPS lands and overseeing the permit process for slash piles that are burned on private property within park boundaries. Slash pile burning operations will comply with RM-18. Slash produced from mechanical projects may also be chipped in place, or chipped and hauled away from the site as indicated in the individual treatment plans.

TOOL #5 – PUBLIC INFORMATION AND EDUCATION

Sequoia and Kings Canyon National Parks are dedicated to providing high quality fire *information and education* for identified target audiences listed later in this chapter. The Fire Information and Education (FI&E) Program at the parks will emphasize the major goals of the *Fire & Fuels Management Plan* to increase public awareness and support.

Contents:

- Goals
- Other Important References
- Staffing
- Key Messages
- Target Audiences
- Communication Methods
- Annual Plan by Season
- Evaluation

Goals

The FI&E Program has four goals:

- GOAL #1 – Offer year-round education on fire ecology, fire history, and fire effects in the southern Sierra Nevada. Communicate how fire and fuels management practices meet natural resource management and community protection goals and thus the mission of the National Park Service.
- GOAL #2 – Provide accurate and timely incident information for local, regional, and national fire operations as needed.
- GOAL #3 – Work with local communities, park residents, and park permittees to promote fire safety, fire prevention, defensible space, fire wise community planning, and fuels management.
- GOAL #4 – Build and maintain interagency, educational, and community partnerships to improve fire education activities.

The Sequoia & Kings Canyon National Parks F&IE Program follows the 2011 Communication Framework for A National Cohesive Wildland Fire Management Strategy, the NPS Fire Communications and Education Strategy, and the Wildland Fire Management Communication Plan. These plans describe a national program that will promote wildland fire management and help people understand fire and its role in ecosystems. Additionally, the Communication Plan for Implementation of Federal Fire Policy also informs and guides park level information and education. The Sequoia and Kings Canyon FI&E Program outlined here, while tailored for the local area, complements the national strategy in its vision, goals, and objectives.

Other Important References

While this document provides the philosophy and general direction for the FI&E Program, there are two other important references for fire information work. Specific operational procedures (checklists, fax numbers, email lists, community contacts, etc.) are outlined in *Standard Operating Procedures: Fire and Fuels Information.* The *Smoke Communication Strategy* (Appendix I of the *Fire* *and Fuels Management Plan*) provides direction for communicating issues related to smoke management.

Staffing

The Fire Information and Education Specialist (in this document referred to as the FIO) is responsible for coordinating the FI&E Program. The success of this program depends on the cooperation and participation of many different partners: Interpretation, Natural Resources, Maintenance, Administration, Fire and Visitor Management, United States Geological Survey (USGS), Sequoia Natural History Association (SNHA), concession employees, and volunteers.

The FIO will serve as the liaison between these different groups to ensure the transfer of information and the consistency of content. When large incidents occur in the parks, the FIO will recruit personnel for specific duties or outside resources will be requested through dispatch procedures.

Key Messages

The FI&E Program will provide target audiences with accurate information about fire management from both the national and local perspective. *The Cohesive Strategy Communication Framework* suggests the following key messages:

- Wildland fire is a dynamic process
- The Cohesive Strategy is about more than fire suppression.
- No one strategy can solve all the problems faced by the nation's fire community.
- The Cohesive Strategy seeks to reflect the values and concerns of the public and all governments.

The Wildland Fire Education Working Team of the National Wildfire Coordinating Group (NWCG) provides interagency key messages so that all five federal land management agencies are using the same key messages to provide clear and consistent communication facilitating better public understanding. These key messages are broad and leave room for individual agency missions and identity:

- Fire is an essential, natural process.
- Society's influence has altered historic fire cycles, leading to a dangerous build-up of vegetation in our wildlands.
- Land management agencies are committed to a balanced fire program that will reduce risks and realize the benefits of fire.
- Fire managers respect the force of fire and take their responsibilities very seriously.
- Improving the health of the land and reducing risks to communities requires partnerships among federal and state agencies, tribal governments, fire departments, communities, and landowners.
- Public education needs to be part of fire management programs.
- Interpreters and other park employees will be able to "bring home" the national key messages by providing examples specific to these parks. Using SEKI's long history of fire operations, monitoring, research, and interpretation, the parks will generate engaging stories for the public while maintaining a level of sophistication appropriate to the topics of fire management, ecology, and history.

Target Audiences

The parks have identified six target audiences for fire information and education messages:

- Park Visitors (including in-park visitors, internet visitors, and special groups)
- Park Employees (including NPS, SNHA, USGS, concessions, and volunteers)
- Local Communities (including residents, businesses inside or near the parks, civic groups, and clubs – Badger, Dunlap, Grant Grove, Hume Lake, Kaweah, Lodgepole, Mineral King, Miramonte, Oriole Lake, Pinehurst, Silver City, Squaw Valley, Three Rivers, Wilsonia and east side communities including Bishop, Lone Pine, Independence, and Mammoth Lakes.)
- Students/Teachers (including K-12 students, college students, elder hostel groups, and teachers)
- Professional peers (including other federal, state, and county agencies, professional associations, and academics)
- Media (including print, television, radio, web based, social networking and film). While media is a valuable communication method, it is listed as a target audience due to the amount of time and energy that goes into facilitating interviews, film projects, etc.

Communication Methods

The following methods will be used to communicate with the six target audiences listed above. There are both personal and non-personal methods which will facilitate reaching the greatest number of people. The parks will continue to improve and expand this list.

Personal

- Interpretive Programs – Park staff will integrate fire messages into hikes, walks, campfire programs, and special off-site presentations. The FIO will audit these programs to ensure content quality.
- Education Programs – Park staff will incorporate fire ecology concepts into standards-based education programs, student field research experiences, and in-class programs.
- "The Fire Place: a mobile learning center" – This small cargo trailer houses exhibits and activities about fire ecology, history, and management. It will be used both on- and off-park at special events and during fire incidents.
- Employee Training – The FIO will coordinate park-wide employee training sessions to improve staff understanding of the fire and fuels management program. These sessions will be open to NPS, USGS, SNHA, concessions and volunteers.
- Roving – During fire operations, park employees will be stationed, as staffing permits, in high use visitor areas, including trails, to answer questions about the current activity and/or explain the fire and fuels management program. Backcountry rangers will also provide information to backpackers about fire operations in their area. Declining staffing within the parks limits the opportunities for roving during fire events in comparison to what was possible in earlier years.
- Conference Presentations – Park staff will give peer presentations at conferences about current fire research, planning, or operations. These presentations will share information, generate feedback, and ultimately improve the parks' fire and fuels management program.
- Special Events – The parks will, when possible, participate in local events to promote the fire and fuels program. For example, park employees can staff booths at local fairs or host community meetings.
- Public Meetings – The parks will conduct special public meetings related to specific fire events, planning effort, or to share general program information as needed.
- Media Interviews – The FIO, or park representative, will complete in-person or phone interviews for print, radio, and television outlets. When necessary, the FIO will facilitate special media projects

(books, documentaries, etc.) by guiding research, scheduling interviews with park staff, and coordinating filming schedules.

Non-Personal

- News Releases/Updates – The FIO will use email, fax, webpages, the parks' Twitter and Facebook accounts, and bulletin boards to distribute press releases/updates for all target audiences as needed.
- Publications – The parks will include fire and fuels information in regular park publications such as the park newspaper. The FIO will research, write, and design additional handouts specifically about fire and fuels management such as newspapers, student materials, and brochures. Available publicatinos will include the *Wildland Fire in the National Parks* brochure developed nationally by the National Park Service.
- Visitor Center Exhibits, Waysides, and Bulletin Boards – The parks will maintain and update the interpretive information in visitor centers and wayside exhibits on fire and fuels management. The FIO will maintain permanent and non-permanent bulletin boards both inside and outside the parks.
- Community Newsletters – The FIO will write, design, print, and send community newsletters to neighboring residents. The pre-season newsletter will coincide with the beginning of fire season and will give residents information about upcoming projects and events. The post-season mailing in winter provides a "wrap-up" of all fire events and reports project accomplishments.
- Success Stories – The FIO will write and design success stories for fire and fuels projects that meet the park's and the *National Cohesive Wildland Fire Management Strategy* objectives. These success stories are submitted on a quarterly basis to PWR and then to NIFC through the FTP folder located at ftp://ftp.den.nps.gov/incoming/fire/SuccessStories. They are posted to the NPS Wildland Fire and Forests and Rangelands webpages. They should also be distributed to park audiences.
- Webpage /Social Media – The parks will maintain a SEKI fire and fuels management webpage called "Fire in the Parks" at http://www.nps.gov/seki/naturescience/fire.htm. The FIO will enter information about park fires into InciWeb, an interagency national database and the recognized interagency database for current fire incident information. InciWeb presents information at http://inciweb.nwcg.gov. The FIO maintains the parks' Twitter account and is an administrator to the parks' Facebook account and ensures information and stories about the fire and fuels management program are integrated into the feed.
- Recorded Phone Message – The FIO will maintain the recorded "Fire Information" message on the main park answering system accessed by calling (559) 565-3341.

Annual Plan by Season

For six to seven months of the year, the FI&E Program is largely in a reactive mode disseminating information about actual fire events. While this is the "nature of the business," the parks must stay focused on larger goals and prevent individual incidents from defining the entire fire education program.

Table 3-1 describes the Education Annual Plan which gives year-round direction for the FI&E Program. Depending on the season, certain educational elements are emphasized. Table 1 highlights these emphasis areas and links them to communication methods and target audiences. It is important to remember that this plan is very general and will not prevent the program from engaging in new, innovative methods in the future.

Evaluation

To maintain a successful FI&E Program, the parks will seek evaluation opportunities such as independent surveys of visitors, residents, and employees. The parks have completed three formal surveys in the past to assess public support and awareness of fire operations. Two surveys focused on park visitors (Quinn 1988 and Oregon State University 2003) and one survey focused on local residents of Three Rivers, California (Schissler Associates 1999). Additional evaluation of the parks' fire information program was reviewed in 2007 (Sowell and Fiske, Washington State University).

The FIO will also evaluate the FI&E Program by preparing an annual report each year that documents the accomplishments. The parks will forward this annual report to the national communications program in Boise.

Table 3-1: Education Annual Plan by Season

	Educational Emphasis	Communication Methods	Target Audiences					
			Park Visitors	Park Employees	Local Communities	Students / Teachers	Professional Peers	Media
Spring	Pre-Season Information	Community newsletter Press releases /updates Webpage Special events / public meetings		*	*		*	*
	Student Education	In-park programs for schools Mobile Learning Center Career days				*		
	Interagency Planning	Interagency work groups Conference presentations					*	
	Recruitment	Job fairs Mobile Learning Center			*	*		
Summer	Incident Information	Press releases / updates Bulletin boards Roving interpretation Mobile Learning Center Recorded phone messages Media interviews / field trips Webpages Special events / public meetings	*	*	*		*	*
	Interpretation	Park-wide interp programs Roving interpretation	*		*			*
	Employee Training	Written materials (handbooks) Training sessions		*				
	Interagency Cooperation	News releases / updates Incident assistance		*			*	
Fall	Incident Information	News releases / updates Bulletin boards Roving interpretation Mobile Learning Center Recorded phone messages Media interviews / field trips Webpages Special events / public meetings	*	*	*		*	*
	Interagency Cooperation	Press releases / updates Incident assistance		*			*	
	Student Education	In-park programs for schools Mobile Learning Center				*		
Winter	Post-Season Information	Community newsletter News releases / updates Webpages Special events / public meetings			*		*	*
	Interagency Planning	Interagency work groups Conference presentations					*	
	Development of New Materials	Printed publications Bulletin boards Promotional items Exhibits / waysides	*	*	*	*	*	*

TOOL #6 – MONITORING

All NPS units that implement wildland fire and fuels treatment activities must develop short- and long-term *monitoring programs* to assess accomplishments and to determine the effects of management activities on cultural and natural resources in the parks. While the fire and fuels management program is based on a broad array of existing scientific research that clearly illustrates the important role of fire in the parks' ecosystems (see Chapter 9), monitoring is essential to provide information about the effects of management activities.

Using feedback from ongoing monitoring results, the fire and fuels management program can adapt to changing needs with the best available information. Monitoring is essential to determine if management objectives are achieved, as well as to detect unexpected and undesired consequences of management activities. This monitoring information is especially useful because it is obtained directly from park management activities, and therefore, has direct, local application. Monitoring and the feedback from monitoring will become increasingly important to managers for understanding and adapting to a changing climate and its effects on park ecosystems and fire.

A *Fire and Fuels Monitoring Plan* (Appendix C) has been developed to describe current monitoring efforts and proposed needs and will be updated annually. The *Fire and Fuels Monitoring Plan* covers the four levels of fire monitoring identified in the *NPS Fire Monitoring Handbook* (USDI NPS 2003) and RM-18 (NPS 2014)including environmental monitoring, fire observation, short-term effects, and long-term effects. The *NPS Fire Monitoring Handbook* provides guidelines for monitoring fire management activities to meet NPS needs. Because the *Fire and Fuels Management Plan* includes mechanical treatment as a tool for fuel and fire manipulation, the monitoring plan also includes protocols for mechanical treatment monitoring. Guidelines for monitoring mechanical treatment are preliminary, with most of the focus on short and long term monitoring, the same as for sites treated with fire.

The parks' *Fire and Fuels Monitoring Plan* applies to monitoring efforts across both spatial and temporal scales, from site-specific up to the landscape-level, and from immediate post-fire to long-term effects. For example, in areas where heavy fuels have accumulated as a result of past fire exclusion, fuels will be monitored to determine when fuel loads have been restored by fire's reintroduction. In other areas where fuel and vegetation conditions have not been greatly altered by fire exclusion, or in areas that have been restored, fire frequency, severity, and season will be monitored to insure the long-term maintenance of the historic fire regime. Correspondingly, in areas where mechanical manipulation of fuels is needed (due to presence of human structures) prior to burning of woody debris piles, fuel loads will be monitored as well as vegetation change.

The plan describes the monitoring program by subject matter including weather and fire behavior, fuels, vegetation, cultural resources, and fire regime. Each subject area section outlines monitoring objectives, sampling design (including specific field protocols), locations, and a schedule appropriate for each subject matter area (Appendix C). Monitoring protocols are reviewed at the regional office level to insure that methods are appropriate and funding for monitoring is adequate.

Information from other monitoring efforts will be used to inform the fire and fuels management program where pertinent. For example, results from the parks' Inventory and Monitoring Network Program may be useful to assess the changes occurring in areas of the parks affected by wildland fires and areas where fire has been excluded for long periods.

TOOL #7 – RESEARCH

Natural, cultural, and social science *research* is and will continue to be an important activity in these parks. Research in this document is defined as *any scientific method that informs the fire management program including monitoring and modeling, as well as traditional research projects.* It serves several primary purposes in relation to the fire and fuels management program. First, it helps to define both natural fire regimes as well as the range of natural conditions that serve as ecological foundations for the application of fire in park ecosystems. Second, it is used as a tool to evaluate actions used to restore and/or perpetuate desired conditions as contemplated in the policies for management of natural areas in the National Park Service. Third, it can potentially provide feedback and direction for new management strategies that may need to be followed if climate change has significant influences on park ecosystems. For example, how or will we be able to manage particular vegetation communities so they are more "resistant" or "resilient" to the effects of fire in a changing climate in the decades ahead. This research can have either tactical or strategic applications. Such research will continue to be encouraged and supported in an effort to further improve the parks' fire and fuels management program.

Considerable fire research has been carried out in Sequoia and Kings Canyon National Parks over the past several decades. This work has included a variety of studies in: sequoia-mixed conifer forests (Kilgore 1972, Kilgore and Taylor 1979, Parsons and DeBenedetti 1979, Harvey and others 1980, Stephenson and others 1991; Swetnam and others 1992, 1998; Swetnam 1993; Mutch 1994; Caprio and Swetnam 1995; Stephenson 1994; Miller and Urban 1999, 2000; Stephens and Finney 2002; Knapp et al. 2005; Ferrenburg et al. 2006; Keifer et al. 2006; Knapp and Keeley 2006; Schwilk et al. 2006; Collins et al. 2007, Collins and Stephens 2007; Knapp and North 2011, 2007; North et al. 2007, Scholl and Taylor 2010, Swetnam et al. 2009; Van de Water and North 2011; North et al. 2009; Lydersen and North 2012) low elevation foothill communities (Rundel and Parsons 1979, Parsons 1981, Rundel and others 1987; Keeley et al. 2005a, 2005b); and high elevation forests and meadows (Vankat 1970; Kilgore 1971, DeBenedetti and Parsons 1984; Pitcher 1981, 1987; Caprio 2004a, 2004b, 2006, 2008). A summary of research on fire in California ecosystems, including the Sierra Nevada, can be found in Sugihara et al. (2006).

These studies provided a firm justification and basis for the development and use of the parks' prescribed and wildland fire management programs (Bancroft and others 1985). While much is known from these studies, in most cases they have not provided the full level of detail necessary to completely understand natural fire regimes or many of the long-term effects of fires of variable severity on subtle ecosystem properties.

Research needs and priorities are jointly identified by the Resources Management and Science and the USGS Sequoia and Kings Canyon Field Station located within the parks. They are documented in the parks' *Natural and Cultural Resources Management Plan* and updated annually. Such research may include in-house studies, interagency or cooperative agreements, contracts, or independent investigations. All fire related research is closely coordinated with fire and fuels treatment operations and fire and fuels monitoring efforts in order to assure maximum application of findings to both the management and interpretation programs. During winter months, fire managers and researchers meet regularly to coordinate future projects and incorporate past research results into the next annual fuels treatment plan. All fire-related research, monitoring, and inventory projects undertaken within a given year are documented in the "Fire Ecology Annual Report".

Most fire research is carried out in close conjunction with the prescribed burning program, utilizing planned burns to the extent possible. On occasion, burns will be carried out specifically to support approved research projects. These might include efforts to study the effects of variable severity or intensity burns, reburns, or burns carried out under specific climatic or prescription variables (e.g. severe drought).

For more detailed information concerning the *Fire and Fuels Research Plan*, see Appendix D.

TOOL #8— EVALUATION: ADAPTIVE FIRE MANAGEMENT

The fire program at Sequoia and Kings Canyon is committed to continuous improvement over time. We achieve this objective by encouraging the fire program to become a Learning Organization. For purposes of this section, the term Learning Organization and Adaptive Management are synonymous. The following definition of a Learning Organization is written by David Gravin from Harvard Business School:

A learning organization is an organization skilled at creating, acquiring, and transferring knowledge, and at modifying its behavior to reflect new knowledge and insights.

The fire program has established a process so we can learn from past operations and events to improve future endeavors. Our goal is an organizational culture that: 1) encourages and rewards the reporting of errors or unintended outcomes 2) finds solutions to small emerging failures before larger problems surface and 3) change our best practices for management of the fire program based on knowledge from our past operations.

The following describes the Learning Organization Process at Sequoia-Kings Canyon:

- Building a Learning Organization. In other to become a successful learning organization, fire managers need to foster an environment that is conducive to learning. Therefore, the fire program has developed a systematic process for fire staff to gain to knowledge and skills necessary to become a learning organization. Each year we train our fire staff the attitudes, process, and mind set of a Learning Organization during our annual preseason training.
- After Action Review. The fundamental building block of the fire program's strategy to become a learning organization is the After Action Review process. Fire managers encourage all levels of the organization to complete After Action Reviews post project work, incident and operation. Every wildland fire and aviation operation will be reviewed via the After Action Review process. Significant events or near misses will be documented in an After Action Review Rollup.)
- Fire Management Safety Committee. Serves as the focal point for the Fire Management Organization's goal of being a Learning Organization. The committee is comprised of a permanent employee from each of the fire crew modules and one fire program manager. Encourages the use of After Action Reviews (AARs) at the end of each operational period during an incident. Reviews significant events identified during AARs and documented by the responsible Incident Commander.
- Annual Updates to the FFMP. Each year the Fire Management Staff updates the FFMP to incorporate the knowledge and lessons learned from the previous year operations. The updating process will use lesson learned discovered during AARs, incident reviews, recommendations from the Fire Management Committee, and fire effects monitoring data to continuously improve the fire management program.
- Five year comprehensive review of the FFMP. Every five years a more comprehensive review and rewrite of the FFMP will occur. Outside subject-matter-experts such NPS Regional Office, US Geological Survey, and local government cooperators may participate in the review process. This review will be more substantive in nature than the annual review. For example fire effects monitoring data should be used to update prescribed burning prescriptions if needed.
- Reviews of significant events and large fires. High complexity wildland fires and prescribed burns warrant more in depth review than a post –incident AAR. Therefore, on high complexity or significant event a formal review will take place one-four months post incident. An outside facilitator may be hired to coordinate and conduct the review.
- Fire Management Committee. The purpose of the committee is to assist the superintendent and the fire management officer in the development, implementation, critique, and review of the fire management program. The committee is an important part of learning organization process for the fire program. The committee will recommend adjustments to fire program based on reviews and

outcomes of wildland fires, prescribed burning activities, impacts to non-fire park programs and fire ecology data.

- Fire Effects Monitoring program. The fire program has a Fire Ecology program that monitors our wildland fires and prescribed burning to determine whether outcomes meet programmatic objectives. A seasonal fire effects monitoring crew establishes vegetation monitoring transects to quantitatively determine the fire effects of our wildland and prescribed fires. The park Fire Ecologist will provide feedback to fire manager son the fire effects data and analysis. This information will be used to refined prescribed burning prescriptions, determine prescribed burning treatment priorities, and validate if we achieving stated programmatic objectives

4. Fire Management Units and the Planning Process

This chapter outlines the planning work that leads to actual project implementation in support of the Fire and Fuels Management Plan. The process is summarized in Figure 4-1. This chapter also describes in detail the parks' Fire Management Zones (hereinafter referred to as "Zones"), Fire Management Units (hereinafter referred to as FMUs), Segments, and Sub-Segments (Tables 4-1 through 4-4).

PROJECT PLANNING AND PRIORITIZATION

All planning efforts begin with the identification and description of areas in need of fire management action or attention. Needs are evaluated in light of park values, wildland fire hazards, and risks (Caprio et al, 1997).

Values are divided into three areas: ecological, cultural, and social. Ecological values include vegetation, water, wildlife, natural processes, and air resources. For example, natural fire regimes (a natural process) are assessed through an analysis of the fire return interval departure (FRID). This analysis reflects the number of fires a piece of land has missed based on that area's maximum natural fire return interval (see special FRID explanation in Figure 4-2). FRID is an indicator of condition class (as defined by Hann and Bunnell) and can be directly related to the national reporting standard for condition class. Cultural resource values include prehistoric and historic cultural sites, historic structures, and contemporary structures, both government-owned and private. Social values include park employees, visitors, neighboring communities, and wilderness.

Fire hazard is defined as a fire's resistance to control. Hazard is determined by factors that affect fire behavior. Examples of factors that affect fire hazard include slope, aspect, fuels, and elevation.

Risk, or probability of fire occurrence, includes both human and naturally caused ignitions.

While the most important attributes of value, hazard, and risk are known, others may be identified and incorporated into decision-making in the future. New research and information is constantly considered to increase the parks' ability to apply the best available knowledge to fire and fuels management. Most of the planning analysis is now done using the parks' geographic information system (GIS), although some analysis work has yet to be automated. Needs analyses are updated annually and can reflect the changes in the parks' understanding of values, hazards, and risks, and incorporate new technologies as those evolve.

With the "needs" analysis typically identifying more acres needing attention than are possible to accomplish in any one year, priorities have to be selected based on a combination of criteria. Each year, managers will select projects that have a high probability of success, and that move resource and hazard fuel conditions towards the desired status as defined by program goals and objectives. To assist in selecting the most important projects from all the areas needing attention, criteria that help identify the highest priority project areas are identified and assigned numerical weight within the park GIS. These numeric values are then processed through a spatial analysis. An interdisciplinary team analyzes outputs of the analysis, and a final suite of high priority projects is selected for implementation.

Selection criteria used to identify high priority project areas may change over time as new scientific or operational considerations warrant. Though subject to change based on new information, selection criteria for the identification of high priority projects may include:

- Areas where hazard fuel conditions threaten developments, firefighter safety, and boundaries
- Areas of frequent natural or human ignition where preventative actions may be useful in preventing unwanted fire.
- Areas of special ecological or social significance (e.g. Giant Forest grove).
- Core fire management maintenance areas representative of the full range of park vegetation communities and wildlife habitats.
- Areas that are presently in good-to-excellent ecological condition as evaluated by the FRID analysis or similar index (e.g. condition class as defined by Hann and Bunnell).
- Areas at risk of moving to a more compromised FRID condition category (e.g. from moderate to high departure from natural) in the next five years.

UPDATE, CERTIFICATION, AND REVIEW

Annual Update

Fire and Fuels Management Plan updates will occur each year to incorporate minor changes in terminology, policy, GIS analysis, and new scientific information. Other typical annual update components will include summary statistics from the previous year's fires, changes to the parks' *Preparedness Staffing Plan*, and readiness calendars. Another major function of the annual update will be to list specific prescribed fire and mechanical fuel reduction projects proposed for the upcoming season, as well as describe planning and implementation projections for an additional four years.

Program Certification

The fire management officer will present the annual updates and proposed program to the Fire Management Committee by mid-June. The Fire Management Committee will review the proposals and confirm that the changes and actions proposed are within the scope of the companion Environmental Assessment (EA) for the *Fire and Fuels Management Plan*. If the nature of any part of the proposal is found to be outside the scope of the plan's EA, additional environmental compliance will be required for the non-conforming actions. After the Fire Management Committee is satisfied with the proposed program, they will recommend adoption to the superintendent. Updates to the fire management program must be approved by the superintendent prior to implementation.

Periodic Review

Five years after final approval, and every five years thereafter, the *Fire and Fuels Management Plan* will receive thorough review to determine whether it remains adequate to direct future fire and fuels management actions. If significant new information, policy changes, or scientific knowledge (such as new information on the effects of global climate change) needs to be incorporated into the fire and fuels management program resulting in effects or consequences not evaluated in the current EA, the plan and EA will be revised. If no substantial changes to program direction or effects are discovered during the review, the plan may be renewed for an additional five years with proper documentation.

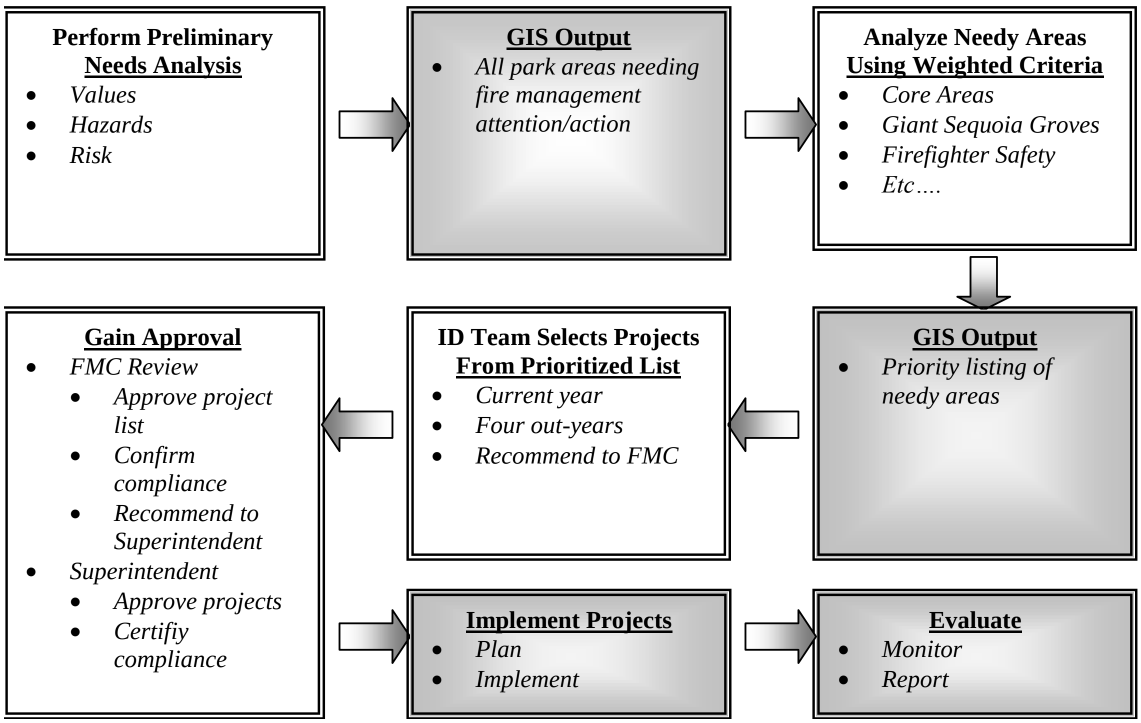


Figure 4-1: Annual Project Planning and Analysis flowchart

Vegetation communities can change dramatically when areas have not been allowed to burn at natural intervals. A geographic information system (GIS) based analysis was used to assess landscape scale change in the ecological condition of vegetation communities in Sequoia and Kings Canyon National Parks. This analysis uses deviations from the natural fire return interval as an indicator of change in natural conditions.

A fire return interval is defined as the number of years between naturally occurring fires at a specific location that is representative of a typical stand of that vegetation. For example, an analysis of fire scar in a stand of ponderosa pine trees might show that natural fire has occurred as frequently as every two years (minimum value) to as infrequently as every six years (maximum value). The mean value for the stand would be four years.

The fire return interval for a given vegetation type can be used in conjunction with fire history maps to determine which park areas have missed natural fires. This information is known as the fire return interval departure (FRID). For example, if fires were suppressed in the above-mentioned stand of ponderosa pine trees for 60 years, the stand would have missed 30 fires based on the minimum fire return interval of 2 years, 15 fires based on the median interval of 4 years, and 10 fires based on the maximum interval of 6 years.

In general, the further vegetation communities depart from their natural fire regimes, the more unnatural conditions prevail and the higher the risk of a stand replacement wildland fire, which is not natural to most Sierran forests. Maximum fire return interval departure (FRID max) represent the most conservative estimate of how severe the deviation from natural conditions might be in terms of fuels and vegetation. Mean fire return interval departure (FRID mean) gives a more moderate view, while the minimum fire return interval departure (FRID min) presents the most extreme indication of how far the stand is from its natural condition. For planning purposes, SEKI uses the most conservative indication of change (FRID max).

The first step is to assign mean and maximum fire return intervals to fire vegetation types (see Table 9-1 in Chapter 9). The second step was to use fire scar, fire history, and fire occurrence data to create a map of when each acre of the park had last burned (Figure 4-3). Fire history maps date back to 1921 for the parks. The final step was to calculate departures from the natural fire interval and create a map that depicts the number of fire cycles missed in each area. (Figure 4-4).

As of the year 2012, results of the FRID analysis indicate that **63%** of park vegetation is considered to be in acceptable ecological condition (i.e. little to no deviation from natural fire regime). These areas are expected to remain in acceptable ecological condition as long as the natural fire regime is maintained. Another **23% of the parks' vegetation** shows significant deviation from natural conditions and 14% of the parks are considered highly compromised by past fire suppression actions over the past 82 years.

FRID is an indicator of condition class (as defined by Hann and Bunnell) and can be directly related to the national reporting standard for condition class as shown in the diagram below.

Vegetation communities can change dramatically when areas have not been allowed to burn at natural intervals. A geographic information system (GIS) based analysis was used to assess landscape scale change in the ecological condition of vegetation communities in Sequoia and Kings Canyon National Parks. This analysis uses deviations from the natural fire return interval as an indicator of change in natural conditions.

A fire return interval is defined as the number of years between naturally occurring fires at a specific location that is representative of a typical stand of that vegetation. For example, an analysis of fire scar in a stand of ponderosa pine trees might show that natural fire has occurred as frequently as every two years (minimum value) to as infrequently as every six years (maximum value). The mean value for the stand would be four years.

The fire return interval for a given vegetation type can be used in conjunction with fire history maps to determine which park areas have missed natural fires. This information is known as the fire return interval departure (FRID). For example, if fires were suppressed in the above-mentioned stand of ponderosa pine trees for 60 years, the stand would have missed 30 fires based on the minimum fire return interval of 2 years, 15 fires based on the median interval of 4 years, and 10 fires based on the maximum interval of 6 years.

In general, the further vegetation communities depart from their natural fire regimes, the more unnatural conditions prevail and the higher the risk of a stand replacement wildland fire, which is not natural to most Sierran forests. Maximum fire return interval departure (FRID max) represents the most conservative estimate of how severe the deviation from natural conditions might be in terms of fuels and vegetation. Mean fire return interval departure (FRID mean) gives a more moderate view, while the minimum fire return interval departure (FRID min) presents the most extreme indication of how far the stand is from its natural condition. For planning purposes, SEKI uses the most conservative indication of change (FRID max).

The first step is to assign mean and maximum fire return intervals to fire vegetation types (see Table 9-1 in Chapter 9). The second step was to use fire scar, fire history, and fire occurrence data to create a map of when each acre of the park had last burned (Figure 4-3). Fire history maps date back to 1921 for the parks. The final step was to calculate departures from the natural fire interval and create a map that depicts the number of fire cycles missed in each area. (Figure 4-4).

Figure 4-2: Description of Fire Return interval Departure (FRID)

Figure 4-3: Comparison or Fire Return Interval Departure (FRID) and Condition Class

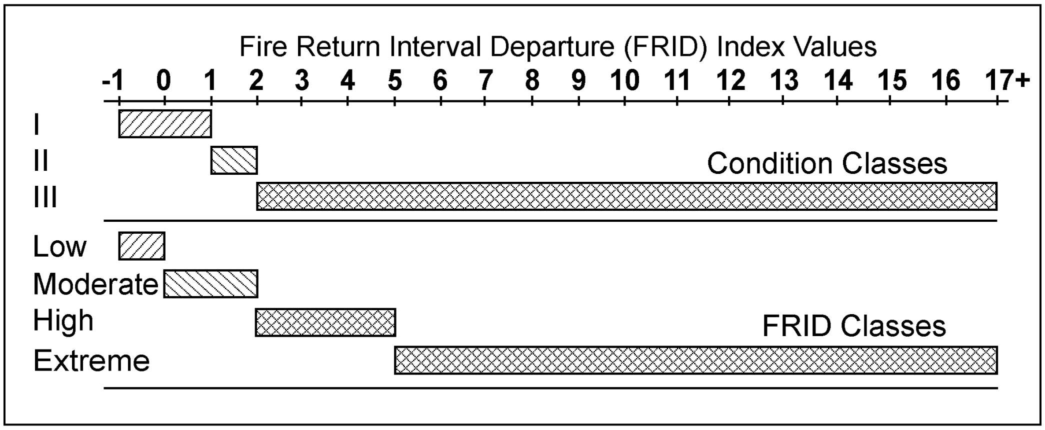


Figure 4-4: Map of Sequoia and Kings Canyon parks Fire History

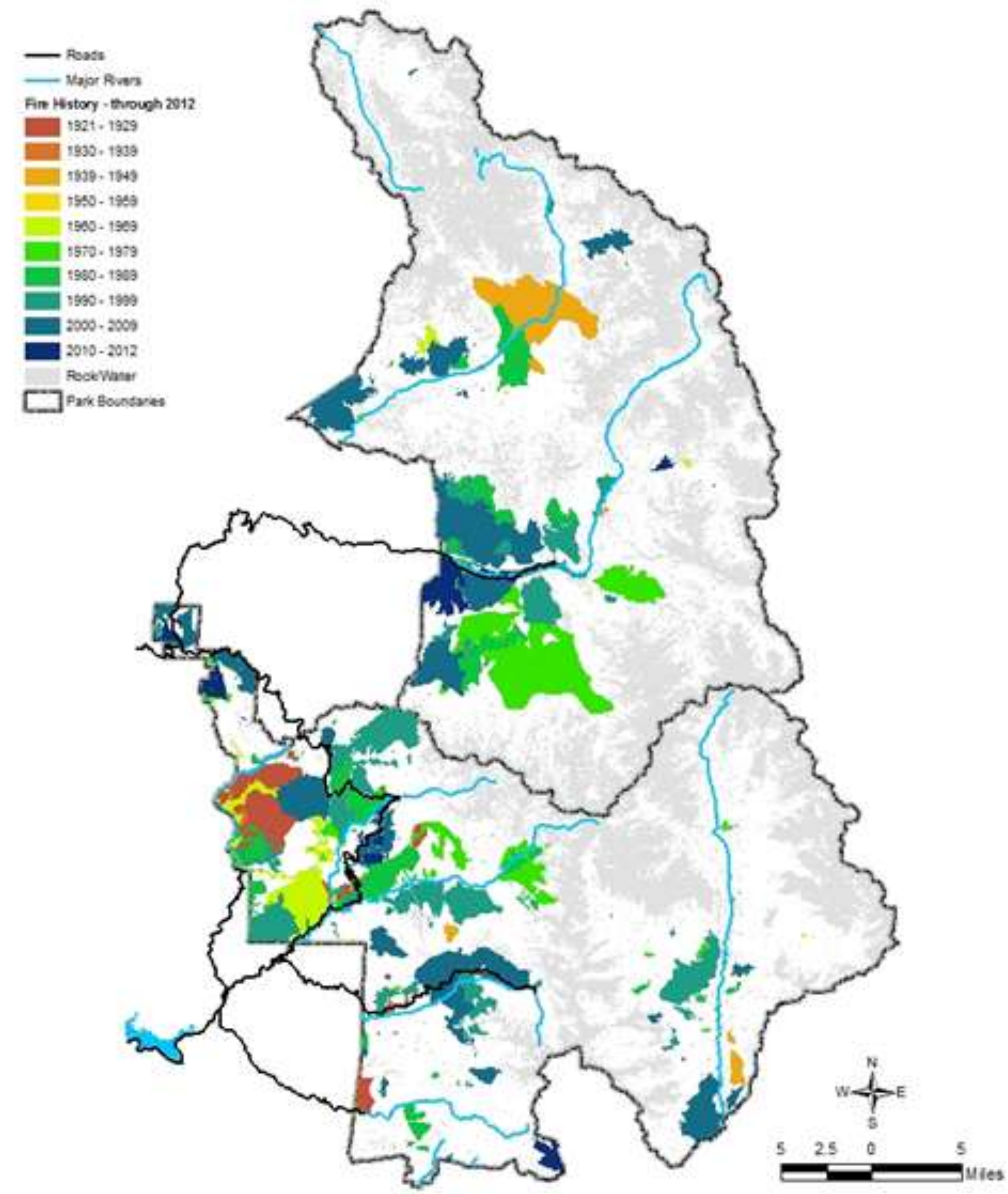


Figure 4-5: Map of Fire Return Interval Departure (FRID)

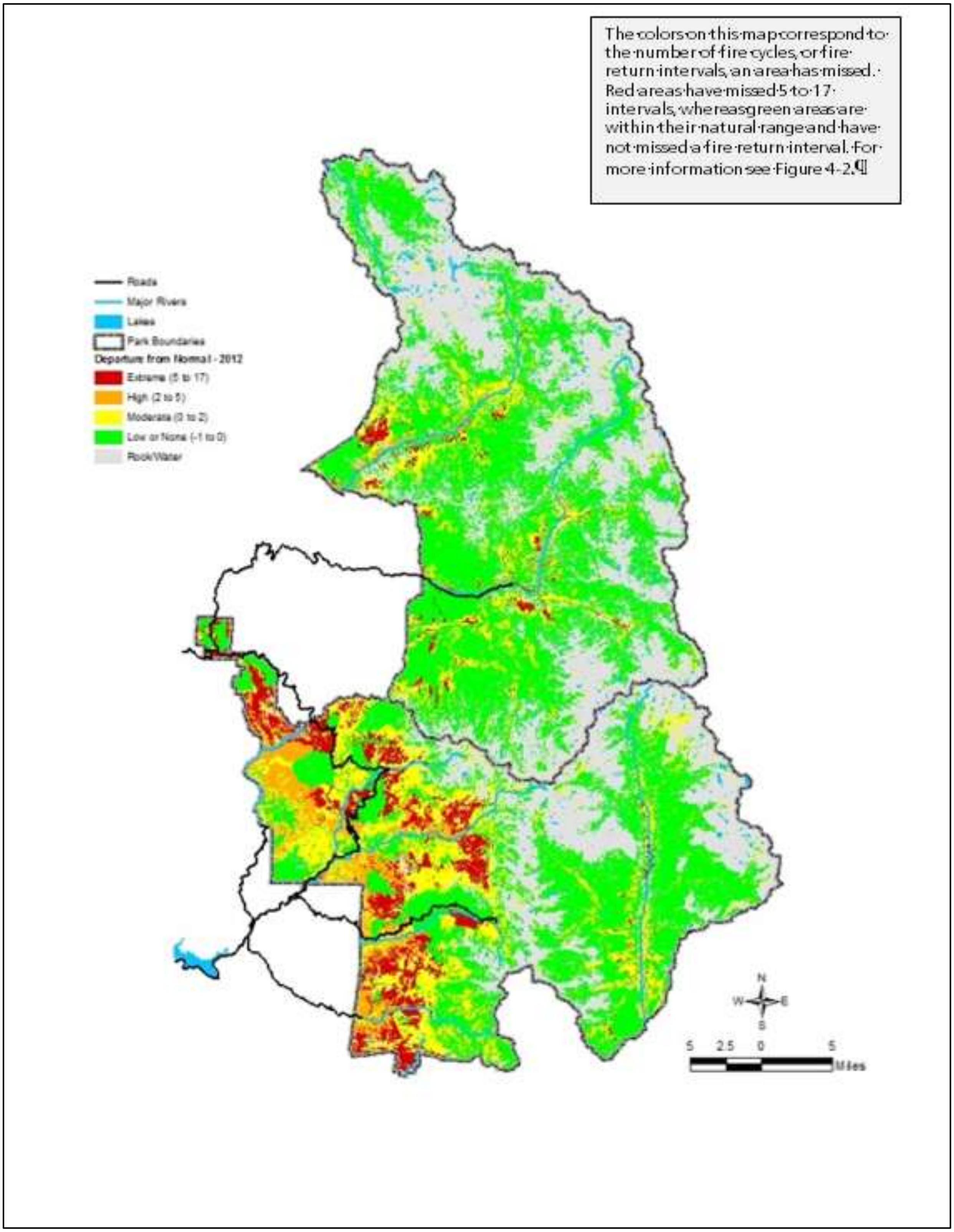
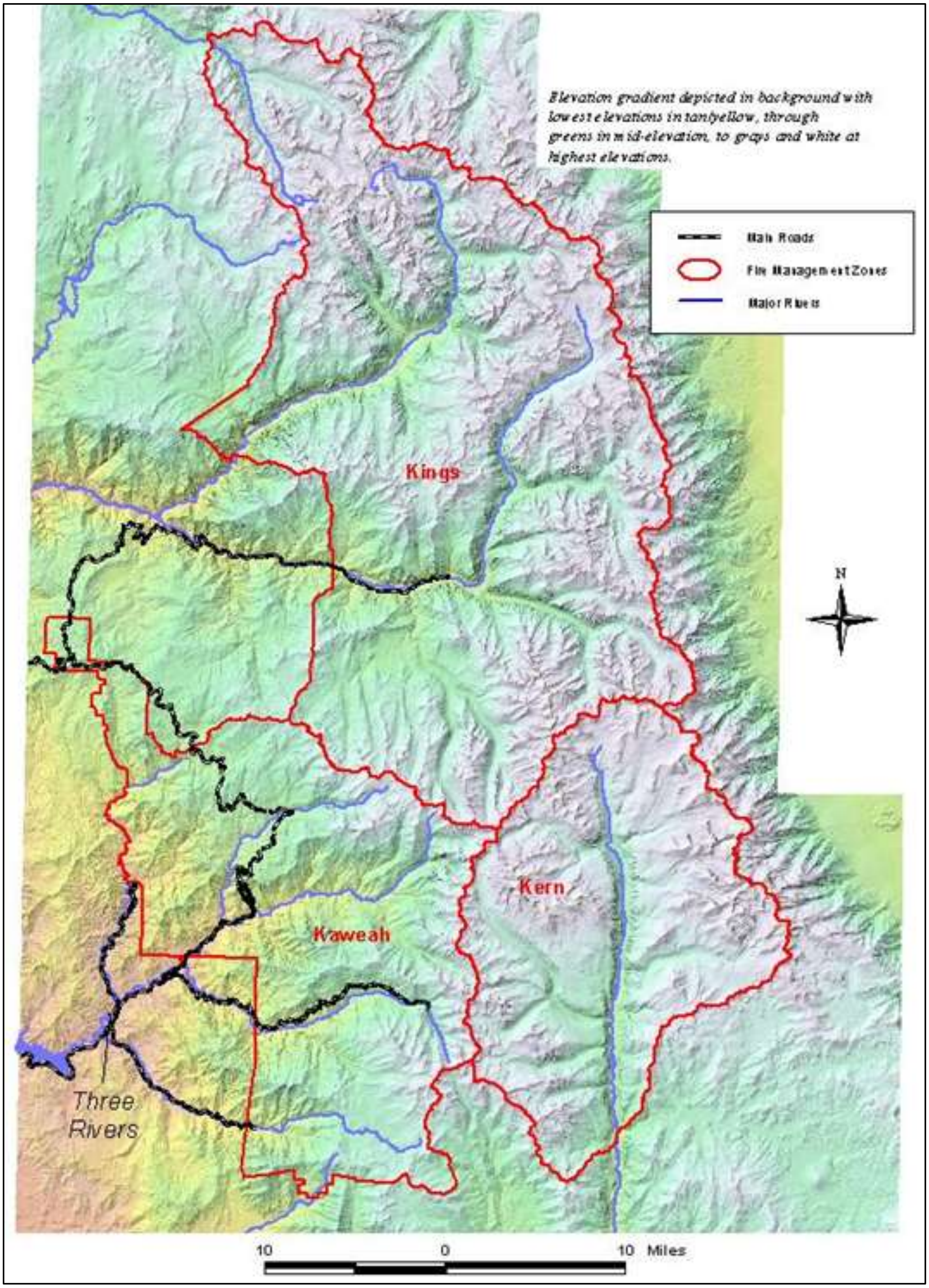


Figure 4-6: Map of Sequoia and Kings Canyon parks Fire Management Zones



FIRE MANAGEMENT ZONES AND UNITS

The parks are divided into three Fire Management Zones - the Kings, Kern, and Kaweah (see Figure 4-6). The Zones represent, for the most part, major park watersheds resulting in an ecologically based planning framework for fire management activities. Each Zone has characteristics that allow unified fire and fuels management concepts to be applied within the Zone.

Zones may be subdivided into smaller Fire Management Units (see Figures 4-7, 4-8, and 4-9). FMUs are generally sub-watersheds having locally unique values, hazards, and/or risks that affect the specific mix of fuels treatments and fire management activities to be used. Because the FMUs are based on sub-watersheds, ecological integrity and landscape level goals and achievements can be evaluated with some confidence.

FMUs may be further subdivided into Segments. Segments are comprised of a portion of a FMU that will receive uniform treatment. Segments are usually defined by natural or human created boundaries that allow for ease of management. Each segment will have a separate action plan developed (burn plan and/or fuels treatment plan). In some cases, segments may be further divided into Sub-segments under the same burn plan or fuels treatment plan to allow greater control and flexibility in managing the duration of the project, smoke impacts, or for other purposes.

Table 4-1: Identification of Fire Management Zones, Units, Segments, and Sub-Segments

Planning Unit	Subset of:	Geographic Extent	Designation	
Fire Management Zone	Parks	Major watershed(s)	Kings Kern	Kaweah
Fire Management Unit (FMU)	Fire Management Zone	Sub-watershed	Kings Zone Sierra Crest Cedar Grove Kern Zone Kern	Kaweah Zone Grant Grove North Fork Marble Fork Middle Fork East Fork South Fork
Segment	FMU	Manageable portion of a sub-watershed receiving common treatment under a single burn plan or fuels treatment plan.	Boundaries determined through annual planning process.	
Sub-Segment	Segment	Portion of a segment. Individual project to be treated along with other segments (though perhaps at different times) under a single burn plan or fuels treatment plan.	Boundaries determined through annual planning process and on-the-ground reconnaissance.	

Table 4-2: Description of Fire Management Zones (FMZ's)

Kings Zone	Kern Zone	Kaweah Zone
Description of Zone The Kings Zone encompasses most of Kings Canyon National Park exclusive of the Grant Grove peninsula. It consists primarily of designated wilderness (99%) with the exception of one seasonally operated non-wilderness developed area (Cedar Grove). The Zone encompasses the headwaters of the South and Middle Forks of the Kings River, as well as headwaters of the South Fork of the San Joaquin River. The forks of the Kings River are designated Wild and Scenic. All but three miles of the 135-mile perimeter of the Zone is bounded by NPS or US Forest Service (USFS) wilderness. The three miles of non-wilderness boundary are shared with the USFS managed Giant Sequoia National Monument. The Kings Zone contains two FMUs – Sierra Crest and Cedar Grove. As of 2007, 94% percent of the acres in the Kings Zone were in a "low" or "moderate" FRID class indicating low deviation from natural conditions. The remaining 7% fall into either the high or extreme category. The numbers indicate that vegetation and fuel conditions on most of the acres within the Zone are in fairly good condition, with some focused need for restoration and increased ecosystem maintenance, primarily in and around developments and along NPS/USFS boundaries. The generally good ecological and fuels conditions within the Zone are largely a result of the past 40 years of management. Most of the Zone was included in the original "natural fire zone" designated in the late 1960s and early 1970s. As a result of this designation, most natural ignitions have been managed for resource benefit over the past 40 years. Extensive prescribed burning has also occurred in and around developments in Cedar Grove, further improving overall conditions.	Description of Zone The Kern Zone consists of 185,569 acres of designated wilderness dominated by the north-south oriented Kern River drainage. The Great Western Divide to the west and the Sierra Nevada crest on the east and north flank the Kern Zone. Elevations in this Zone range from a low of 6,300 feet at the Kern River ranger station, to 14,495 feet at the summit of Mt. Whitney. The potential for fire spread out of the Zone to the north, east, and west is fully constrained by high rocky ridges and passes. Over 50% of the zone is comprised of rock or water, further limiting fire spread within the zone. Fire spread outside park boundaries onto USFS lands to the south and southeast is possible. All USFS lands adjacent to this Zone are designated wilderness and managed by the Inyo and Sequoia National Forests. The vegetation within the Zone consists of long needle pine forest and montane chaparral at the lower elevations. The vegetation grades rapidly with increasing elevation into lodgepole and subalpine conifer forest; with the latter comprising over 50% of the vegetated acreage in the Kern Zone. Over 82% of vegetated acres show little or no deviation from desired conditions as represented by a FRID classification of "low." Only 2% of the vegetated acres show significant deviation from natural conditions as represented by the "high" or "extreme" FRID class. Other than several backcountry ranger stations and numerous trails, the Zone is free from human developments. No private lands occur within the Zone. Due to its physical isolation and uniformly good fuel and ecosystem condition, the entire Kern Zone is treated as a single FMU with no subdivisions.	Description of Zone The Kaweah Zone is comprised of the various forks of the Kaweah River, as well as the headwaters of the North Fork of the Tule River, several small streams that flow into the Kings River, and a sub-watershed that flows into the Little Kern River. It is managerially the most complex of the three Zones and is subdivided into six FMUs. Topographically most of the Zone faces the San Joaquin Valley to the west and is backed by the Great Western Divide on the east – significant factors in smoke dispersion and air quality issues. As of 2007, the San Joaquin valley is classified as non-attainment for PM-2.5 and ozone. The Kaweah Zone contains most of the parks' infrastructure and developments, all of the parks' giant sequoia groves, and has the greatest diversity of boundary interface issues. The Zone includes five designated or proposed Historic Districts or Landscapes and numerous archeological sites. Due to its proximity to developed areas and typically heavy fuel loads, air quality is a primary concern in all fire management decisions in the Kaweah Zone. The ease of access, ability to detect ignitions, and the presence of extensive developments dating back to the late 19th and early 20th centuries resulted in most of the Kaweah Zone being significantly affected by past fire suppression. Results of those suppression actions are the high fuel loads over a significant portion of the landscape and altered ecosystems. As of 2007, over 34% of the vegetated acres in the Kaweah Zone fall into the "high" or "extreme" FRID classes, indicating extensive deviation from natural conditions. However, because of the compromised ecological state and the high importance of restoring giant sequoia grove conditions in the Kaweah Zone, much of the parks' prescribed fire program has been focused here since 1968. As a consequence of 40 years of proactive fire management, 65% of the vegetated lands are currently in the "low" (34%) or "moderate" (31%) FRID class - indicating improving overall ecological and fuels conditions.
Fire and Fuels Objectives for Zone	Fire and Fuels Objectives for Zone	Fire and Fuels Objectives for Zone

Kings Zone	Kern Zone	Kaweah Zone
Restore and maintain natural ecosystem function to the extent possible using prescribed fire, non-fire fuel treatments, and use of wildland fire, with use of wildland fire expected to be used as the primary management tool throughout much of the Zone. Protect visitors, staff, cultural resources, and infrastructure values in the developed area and along NPS/USFS boundary areas through a program of mechanical and prescribed fire treatments.	Maintain natural ecosystem function to the extent possible using use of wildland fire as the primary management tool throughout the Zone. Protect visitors, staff, park resources, NPS/USFS boundary interface areas, and infrastructure values through implementation of small mechanical fuels management projects and prescribed fire treatments.	Fully restore and maintain natural ecosystem function to the extent possible using prescribed fire, mechanical fuel treatments, and use of wildland fire. Protect visitors, staff, cultural resources, communities, and infrastructure values in the developed area and along the boundary through a program of fire suppression, mechanical fuel treatments, and prescribed fire treatments. Minimize smoke impacts in local communities and to regional airsheds. Promote increased knowledge through fire research. Offer educational opportunities for the public to observe and/or study fire management.
Size and Composition (Acres)	Size and Composition (Acres)	Size and Composition (Acres)
Vegetation 222,434 Rock/Water 221,187 Total 443,621 Wilderness 99%	Vegetation 110,367 Rock/Water 75,284 Total 185,651 Wilderness 100%	Vegetation 205,522 Rock/Water 30,469 Total 235,991 Wilderness 80%
Values, Hazards, and Risks Each Zone is described below based on six different values: 1) special designations and features, 2) park developments, 3) vegetation, 4) private lands, 5) cultural resources, and 6) boundary interface; along with hazard and risk factors. The values are not in priority order.		
Value 1: Special Designations & Features 99% of the Zone is designated wilderness. The South and Middle Forks of the Kings River, from headwaters to the park boundary, are designated as Wild and Scenic Rivers. Cedar Grove contains two buildings on the List of Classified Structures (LCS); the Knapp Cabin and the Cedar Grove storage shed (building #276). The Kings backcountry contains several LCS structures including the Barton-Lackey Cabin, and several "Shorty Lovelace" structures.	Value 1: Special Designations & Features The entire Zone is designated wilderness. In the draft Wild and Scenic River Plan (a component of the draft GMP), the Kern River is considered eligible for Wild and Scenic River status. The parks' General Management Plan (in revision as of 2002) will determine final eligibility. The Kern Ranger Station, Kern River bridge, and associated features are considered cultural resources on the List of Classified Structures. They require particular protection and consideration in all fire management decisions within the Zone. While not carrying a special designation, the Kern hot spring is a unique geothermal feature that occurs on the canyon floor. This site is an attractive and well-used feature within the Zone.	Value 1: Special Designations & Features See Table 4-9.
Value 2: Park Developments Cedar Grove – This 2,700 acre non-wilderness development zone includes a variety of infrastructure	Value 2: Park Developments Several NPS wilderness ranger stations, along with trails and associated bridges are the sole developments in	Value 2: Park Developments See Table 4-9.

Kings Zone	Kern Zone	Kaweah Zone
elements including; a road system, 4 campgrounds, a 13-unit hotel, market, concession operated pack station, park offices, maintenance, park and concession employee housing, sewer and water treatment plants, a helispot, two visitor contact stations, and numerous trailheads. A portion of the Kings Wild and Scenic River bisects the developed area.	the Zone.	
Value 3: Vegetation Mid-elevation hardwoods and ponderosa pine communities grade upward with elevation into mixed conifer, red fir, and lodgepole forests, with subalpine conifers dominating near treeline. Forested areas intermixed with meadows and montane shrublands increase diversity across the Zone. No giant sequoia groves are located in the Kings Zone. Local to widespread invasion of the non-native cheatgrass (Bromus tectorum) has been observed in recently burned areas. Research into cause and effect, and potential management responses is underway.	Value 3: Vegetation The vegetation within the Zone consists of long needle pine forest and montane chaparral at lower elevations, grading rapidly with increasing elevation into lodgepole and subalpine conifer forest. The latter comprises over 50% of the vegetated acreage within the Zone. Approximately 2,300 acres are meadow communities.	Value 3: Vegetation See Table 4-9.
Value 4: Private Lands None	Value 4: Private Lands None	Value 4: Private Lands See Table 4-9.
Value 5: Cultural Resources There are a number of known archeological sites in the Zone, and potential for unknown surface and subsurface archeological resources. Four historic structures on the List of Classified Structures are in the Cedar Grove FMU and several others exist in the Sierra Crest FMU. All require protection from fire. Refer to Appendix H for a current list of protected structures.	Value 5: Cultural Resources There are known archeological sites in the Zone, and potential for unknown surface and subsurface archeological. Five historic structures or features are on the List of Classified Structures the Kern Zone. All require protection from fire. Refer to Appendix H for a current list of protected structures.	Value 5: Cultural Resources See Table 4-9.
Value 6: Boundary Interface Three miles of boundary are shared with the USFS Giant Sequoia National Monument The remaining Zone boundary is shared with USFS wilderness (Monarch, Jennie Lakes, and John Muir) and the Sequoia-Kings Canyon Wilderness. Adjacent USFS areas are in the process of developing use of wildland fire programs and standards which may increase the ability of the park to manage use of	Value 6: Boundary Interface The entire 80-mile Zone boundary abuts designated or proposed wilderness. Over one-half of the Zone boundary is adjacent to USFS wilderness, though a significant portion of that boundary interface does not have vegetation capable of supporting fire. The remaining portions of the Zone boundary are adjacent to NPS designated or proposed wilderness.	Value 6: Boundary Interface See Table 4-9.

Kings Zone	Kern Zone	Kaweah Zone
wildland fire projects across agency boundaries. Each ignition in areas of continuous cross-boundary fuels will be managed as a unique event between the agencies with close coordination. At the present time most fires will be contained within the park.		
Hazards As of 2007, 94% percent of the acres in the Kings Zone were in a "low" or "moderate" FRID class indicating low deviation from natural conditions. The remaining 6% fall into either the high or extreme category. The numbers indicate that vegetation and fuel conditions on most of the acres within the Zone are in fairly good condition, with some focused need for restoration and increased ecosystem maintenance, primarily in and around developments and along NPS/USFS boundaries. Fuels in Cedar Grove can have high rates of spread under strong canyon wind conditions common in the afternoons during fire season. The presence of developments and wildlands in Cedar Grove's ponderosa pine, black oak, and grass-shrub communities create interface issues and concerns for visitor and staff safety. Continuous vegetation crossing the park boundary onto USFS lands along portions of the western boundary (especially the Crown Valley drainage) reduce opportunities for managing wildland use fires in those areas at the present time. However, the USFS will accommodate use of wildland fire in a number of other areas adjacent to the parks. Implementation of wildland and prescribed fire projects requires coordination and cooperation between agencies. Heavy and/or continuous fuel accumulations along with steep terrain are found Sheep Creek drainage along the NPS/USFS boundary. Kings Canyon tends to funnel strong up-canyon winds during the day and moderate down-slope winds at night. The development of a strong thermal belt is common in this area.	Hazards As assessed by the FRID model, ecological conditions in the Kern Zone are substantially in their desired condition. Ninety-four percent of the vegetated acres in the Kern Zone are described as mixed conifer forests generally comprised of Red Fir with low-moderate fuel load. Continuous fuels across a limited portion of the southern and southeastern boundary between NPS/USFS lands could conduct fires both into and out of the park. The USFS is willing to accommodate use of wildland fire in areas adjacent to the parks. Implementation of use of wildland fire and prescribed fire projects requires coordination and cooperation between agencies. Ignitions in the vicinity of ranger stations (especially the Kern station), such as occurred in 2003, require special consideration for safety, and for the preservation of infrastructure and cultural resource values. The Kern Canyon can experience strong canyon winds during the fire season. Thunderstorms along the high elevation ridges may create downdrafts.	Hazards See Table 4-9.
Risks Moderate levels of backcountry visitor use combined with vehicular access to the Cedar Grove portion of this Zone increase the risk of human caused fires. Low elevation fuels consisting of long leaf pine, annual and perennial grasses and forbs, and oaks may result in fast moving fires under windy conditions typical of summer	Risks Moderate levels of backcountry visitor use increase the risk of human caused fires, though human caused fires in this zone are rare. Low elevation fuels consisting of long leaf pine, annual and perennial grasses and forbs, and oaks may result in fast moving fires under windy conditions typical of summer afternoons in the canyon.	Risks See Table 4-9.

Kings Zone	Kern Zone	Kaweah Zone
afternoons in the canyon. Most human ignitions in this Zone occur in close proximity to the Cedar Grove developments, and along the Rae Lakes trail corridor. Lightning ignited fires are common throughout the vegetated portions of the Zone, most commonly occurring in the Sheep Creek drainage, and in the Roaring River/Sugarloaf watersheds, with some also in Tehipite Valley. Other significant lightning fires have occurred on the south aspect slopes and ridges above Cedar Grove. This includes the 2005 Comb WFU, which burned more than 14,000 acres on USFS and NPS lands within the canyon.	Lightning ignited fires are common throughout the vegetated portions of the Zone, with most occurring on ridges and benches west of the Kern River. This includes the 6,000 acre West Kern WFU, which occurred in 2003 and was managed on both USFS and NPS lands within the canyon.	

Note: Due to the number and complexity of the FMU's in the Kaweah Zone, those descriptions are found separately in Table 4-4.

Table 4-3: Description of Fire management units (FMU's) in Kings and Kern Zones

Kings Zone		Kern Zone
Sierra Crest FMU	Cedar Grove FMU	Kern FMU
Description The Sierra Crest FMU consists entirely of designated wilderness, almost entirely contained within a much larger matrix of wilderness managed by the NPS and USFS. All of the South and Middle Forks of the Kings River are designated as Wild and Scenic. Geographically deep glacial canyons divided by rocky alpine ridges characterize the FMU. It is worth noting that nearly 50% of the FMU consists of rock, water, or similar features that dramatically limit fire spread. Fire spread between sub-drainages is rare, and is hindered by extensive rock and other natural features such as rivers and wet meadows. Wilderness use consisting of day hikers, backpackers, and stock parties is heavy in some areas such as the Rae Lakes loop, along the Pacific Crest Trail, and in the Roaring River drainage. Many other areas are seldom visited. Much of the FMU has been managed as a "natural fire zone" since at least 1970, with most lightning ignitions managed for resource benefit. The parks' largest natural fire event, the 14,000 acre Ferguson fire, occurred in the Roaring River drainage in 1977. Because of the remote location, generally acceptable fuels and ecosystem conditions, and dissected terrain that allow for safe management of long term and widespread fire events, the primary fire management strategy in this FMU is to optimize the use of use of wildland fire consistent with fire management resources, interagency concerns, and air quality issues.	Description Within the greater Kings Zone is the 25,400-acre Cedar Grove FMU. It consists of the 2,700-acre Cedar Grove developed area and two wilderness sub-watersheds adjacent to the park boundary (Sheep Creek and Lewis Creek). The Sheep Creek watershed feeds the potable water system for most Cedar Grove developments. Care is needed in burning this watershed to minimize erosion and sedimentation that will temporarily affect filtration needs for the water system immediately post-burn. While the overall fire and fuels management objectives for the Zone apply in this FMU, due to its proximity to USFS lands, intensive visitor developments, and lower elevation fuels – the mix of management strategies vary from those applied in the greater Kings Zone. The primary difference is a lesser reliance on use of wildland fire, and a consequent increase in the use of prescribed fire and non-fire fuels management strategies to both maintain ecosystem function as well as reduce hazardous levels of fuels in and around developments. Non-fire fuel treatments are intended for use in small focused areas immediately adjacent to developments, boundaries, and infrastructure. Management of wildland fire projects may occur in this FMU, though it is expected to be a rare occurrence in the near term. After the Sheep Creek and Lewis Creek segments are treated with prescribed fire, the probability of allowing use of wildland fire should increase and become the dominant management strategy, subject to the USFS ability and desire to accept such events across agency boundaries.	Description (The Kern Zone and Kern FMU are synonymous. See Kern Zone description in Table 4-7)
Size and Composition Vegetation 236,490 Rock/Water 181,727 Total Acres 418.217	Size and Composition Vegetation 23,523 Rock/Water 1,876 Total Acres 25,400	Size and Composition Vegetation 110,366 Rock/Water 75,284 Total Acres 185,560

Kings Zone		Kern Zone
Sierra Crest FMU	Cedar Grove FMU	Kern FMU
Wilderness 100%	Wilderness 90%	Wilderness 100%
Actions Common to all Fire Management Units Human caused fires – other than those intentionally set by NPS staff or park residents under an approved burn plan or permit – will be suppressed under strategies (confine, contain, control) commensurate with firefighter safety and consideration for resource protection from suppression actions.		
Multi-Year Projects and Actions All of the Sierra Crest FMU will be managed for natural process applying use of wildland fire as the primary tool. Minor firing and burnout operations to manage and contain use of wildland fire projects will be conducted as needed, as will construction of firelines using minimum impact standards. Use of wildland fire acreage will vary each year depending on number of natural ignitions and final fire size. Prescribed fire under an approved burn plan may be used along boundary areas to replace suppressed ignitions and maintain the natural fire regime within the zone. Prescribed fire ignitions will be managed to simulate the pattern and spread of natural ignitions.	Multi-Year Projects and Actions The Cedar Grove developed area of the FMU will be managed primarily through the use of prescribed fire throughout the valley, and the use of mechanical fuel removal in limited areas along boundaries and around structures. Prescribed fire projects will be planned on a schedule that mimics the natural fire regime. The majority of the area from the Lewis Creek drainage to the Copper Creek Drainage was restored to its normal fire return interval during the 2005 Comb WFU. This will provide continued opportunity to manage natural ignitions on this slope for resource benefits. Although the 2006 Roaring WFU initiated the process to restore fire to the south side of Kings Canyon, significant challenges remain in managing fire in the Sheep Creek drainage. As natural fuel conditions, use of wildland fire projects may be considered in all areas of the unit. To implement fire use projects, firing and burnout operations will be conducted as needed to contain the fire, as will construction of firelines using minimum impact standards.	Multi-Year Projects and Actions All of the Kern FMU will be managed for natural process applying use of wildland fire as the primary tool. Minor firing and burnout operations needed to manage and contain use of wildland fire projects will be conducted as needed, as will construction of firelines using minimum impact standards. Use of wildland fire acreage each year will vary depending on number of natural ignitions and final fire size. Prescribed fire and Use of wildland fire may be used along NPS/USFS boundary areas and maintain the natural fire regime. Prescribed fire ignitions will be managed to simulate the pattern and spread of natural ignitions. Minor mechanical fuel treatments may be implemented to provide protection of historic structures in the vicinity of the Kern Ranger Station and around other structures as needed.
Further Compliance Needs The scope of proposed actions and their expected effects are described in the companion Environmental Assessment (EA). All mitigating actions contained in the EA will be implemented for projects conducted within this unit. Cultural resource consultation with the park archeologist will take place during the planning phase for all projects. In addition, mechanical fuel projects will require consultation with park wildlife and plant ecologists during the planning phase to ensure adequate protection for site specific species. Other than actions noted above or as contained in the EA, no additional environmental compliance will be	Further Compliance Needs The scope of proposed actions and their expected effects are described in the companion Environmental Assessment (EA). All mitigating actions contained in the EA will be implemented for projects conducted in this unit. Cultural resource consultation with the park archeologist will take place during the planning phase for all projects. In addition, mechanical fuel projects will require consultation with park wildlife and plant ecologists during the planning phase to ensure adequate protection for special status species. Other than actions noted above or as contained in the EA, no additional environmental compliance will be	Further Compliance Needs The scope of proposed actions and their expected effects are described in the companion Environmental Assessment (EA). All mitigating actions contained in the EA will be implemented for projects conducted in this unit. Cultural resource consultation with the park archeologist will take place during the planning phase for all projects. In addition, mechanical fuel projects will require consultation with park wildlife and plant ecologists during the planning phase to ensure adequate protection for special status species. Other than actions noted above or as contained in the EA, no additional environmental compliance will be

Kings Zone		Kern Zone
Sierra Crest FMU	Cedar Grove FMU	Kern FMU
required for projects that fall within the scope of projects and effects described in the EA.	required for projects that fall within the scope of projects and effects described in the EA.	required for projects that fall within the scope of projects and effects described in the EA.

Table 4-4: Description of Fire Management Units (FMU's) in the Kaweah Zone

Kaweah Zone					
Grant Grove FMU	North Fork FMU	Marble Fork FMU	Middle Fork FMU	East Fork FMU	South Fork FMU
Description While the smallest FMU in the park, the Grant Grove unit contains significant resources including "The Nations Christmas Tree" (the General Grant tree), the largest intact giant sequoia grove (Redwood Mountain), extensive caves, and outstanding accessible wilderness areas. This FMU also contains the most intensively developed area in the parks. The NPS managed Grant Grove developed area completely surrounds Wilsonia; a private community of over 100 seasonally occupied vacation homes. The presence of extensive public and private developments creates classic wildland urban interface conditions. The FMU is long and narrow, and shares most of its 54-mile boundary with the USFS managed Giant Sequoia National Monument. The FMU also shares 1.6 miles of boundary with the State of California at Whitaker Forest and one mile of boundary with private lands at Sequoia Lake. As of 2007, 57% of the vegetated acres in the	Description The North Fork FMU is one of the least accessible and most varied FMUs in the Kaweah Zone. The FMU contains a wide range of plant communities - starting with low elevation foothill chaparral, changing to mixed conifer forest containing four giant sequoia groves at mid-elevation, and ranging upward into red fir forest. Other than the main park road bisecting the FMU at mid elevation, development in this unit is limited to a seasonally operated campground (Dorst), a seasonal park residence (Cabin Creek), and the Crystal Cave interpretive site and access road. Few trails penetrate the interior of the FMU. Limited access, extensive boundary exposure, continuous fuels providing connectivity between foothills chaparral and mid-elevation mixed conifer, and steep terrain all present challenges to pro-active fire and fuels management of the North Fork FMU. This unit has the highest	Description As the second smallest Fire Management unit in the Kaweah Zone, the Marble Fork represents the only watershed that is completely contained within park boundaries. The FMU contains most plant communities, including all or a portion of two sequoia groves, and the largest tree in the world (General Sherman). The Giant Forest grove extends across the Giant Forest plateau into the Middle Fork drainage, and is the only grove in the parks that spans two watersheds. Large portions of the Giant Forest grove are under active restoration in areas of prior development. Fire plays a significant role in the restoration program, and will be returned fully to its natural role at some point in the future (approximately 2010). The unit contains major park developments including two campgrounds, employee housing, two visitor centers, visitor lodging and related services, and	Description The Middle Fork is the largest of the Kaweah fire management units encompassing over 75,000 acres, 95% of which are in designated or proposed wilderness. This bowl-shaped drainage contains the lowest elevations in the parks as well as the Great Western Divide at its eastern boundary. The unit includes all of the parks' major plant communities and fuel models. Four sequoia groves are completely contained in the unit, in addition to the southern portion of the Giant Forest grove Developments include the parks' headquarters, employee housing, a visitor center, and campground. The upper two-thirds of the unit are remote wilderness making access difficult. The only road access is the main park highway along the bottom third of the unit. The gateway community of Three Rivers sits at the confluence of the Middle Fork and two other rivers at the bottom of this	Description The East Fork fire management unit encompasses some of the most accessible high elevation in the park. Topographically it is a long steep west-facing drainage with high ridges forming the northern and eastern boundary. More open on the southern perimeter across the Hockett Plateau, this drainage ventilates smoke more readily than the Middle Fork. The East Fork contains all the parks' vegetation communities and fuel models, including a dozen distinct giant sequoia groves. The ease of access is due to the Mineral King road that follows up the drainage parallel to the river from the foothills to near tree line. Along the road are various park and private developments and the road corridor itself has been determined eligible as a National Historic District. Park developments include 2 campgrounds, an entrance station, park housing and administrative	Description The South Fork unit contains twelve giant sequoia groves, including the recently acquired Dillonwood grove. The Dillonwood addition will undergo a separate park planning process, and may include active restoration and fire research opportunities. Having few developments and little road access, the South Fork remains one of the least visited portions of the parks. Developments are limited to a single primitive campground and related entrance road just inside the west park boundary. Ninety-five percent of this unit is in proposed wilderness. Forming the southwest corner of the parks, the South Fork has a high proportion of its boundary shared by other federal agencies and private landowners. This unit contains most park vegetation communities in the park and has the second highest proportion of chaparral of all FMUs.

Kaweah Zone					
Grant Grove FMU	North Fork FMU	Marble Fork FMU	Middle Fork FMU	East Fork FMU	South Fork FMU
Grant Grove FMU were in "high" or "extreme" FRID classes, indicating a high amount of deviation from desired natural conditions. Of all the FMUs in the park, the Grant Grove FMU has the highest rate of compromised acres. These ecological conditions are correlated with high fuel loads and a dense overstory in the mixed conifer vegetation type dominant within the FMU. An infrequent outbreak of the native Douglas fir tussock moth in 1998-2000 resulted in a high mortality of white fir trees throughout the FMU. The high mortality left behind increased fire fuels in all size classes.	proportion of chaparral of all FMUs. Chaparral fuels are generally highly volatile and available to ignite and burn through a large portion of the year. This factor, along with the large amount of external boundary exposure and difficult access strongly influences fire management decisions in the unit. Nearly half of the acres in the FMU are in the high-extreme FRID class, the second highest deviation from desired conditions among all the FMUs in the parks. There is significant potential for rapid large fire development in this unit.	numerous roads. The unit is bisected in the middle elevations by the major park road – the Generals Highway. The half of the unit above the Generals Highway is completely roadless. The interior of the roadless areas is difficult to access and extremely steep and rugged. Few natural barriers to fire spread occur within the unit or between this unit and adjacent fire management units.	drainage. Due to the unique topography of this drainage (large bowl shape and high ridges to the east) smoke from fires vents less readily here than in other drainages in the parks. The pooling of smoke results in nighttime drainage of smoke into the community under certain meteorological conditions.	functions, and a ranger station. Private developments include numerous cabins on both private and leasehold lands generally grouped into 5 small communities. The road as an ignition source and the risk to interface communities and developments along the road are of particularly high concern when addressing fire management in this unit.	Difficult access, broken terrain, volatile fuels, and cross boundary fire management concerns pose significant challengers for fire management. This unit has significant potential for rapid large fire development
Size & Composition Vegetation 14,698 Rock/Water 563 Total 15,211 Wilderness* 56% *Proposed wilderness.	Size & Composition Vegetation 30,389 Rock/Water 533 Total 30,389 Wilderness* 86% * Includes designated and proposed wilderness.	Size & Composition Vegetation 28,441 Rock/Water 5,157 Total 33,598 Wilderness* 64% *Includes designated and proposed wilderness.	Size & Composition Vegetation 58,605 Rock/Water 14,942 Total 73,547 Wilderness* 90% *Includes designated and proposed wilderness.	Size & Composition Vegetation 42,954 Rock/Water 7,187 Total 50,141 Wilderness* 68% *Includes designated and proposed wilderness.	Size & Composition Vegetation 30,482 Rock/Water 2,088 Total 32,570 Wilderness* 95% *Proposed wilderness.
Each Kaweah FMU is described below based on six different values: 1) special designations and features, 2) park developments, 3) vegetation, 4) private lands, 5) cultural resources, and 6) boundary interface; along with hazard and risk factors. The values are not in priority order.					
Value 1: Special Designations & Features 56% of the FMU is proposed wilderness. Most Grant Grove	Value 1: Special Designations & Features 86% of the FMU is designated or proposed wilderness.	Value 1: Special Designations & Features 64% of the unit is designated or proposed wilderness	Value 1: Special Designations & Features 90% of the FMU is designated or proposed wilderness.	Value 1: Special Designations & Features 68% of the unit is designated or wilderness The Mineral King road and	Value 1: Special Designations & Features 95% of the unit is proposed wilderness. Critical habitat for the

Kaweah Zone					
Grant Grove FMU	North Fork FMU	Marble Fork FMU	Middle Fork FMU	East Fork FMU	South Fork FMU
developments are within the proposed "General Grant National Park National Historic District". Wilsonia (including some NPS structures) is a National Historic District. The General Grant Tree is designated by presidential proclamation as "the Nation's Christmas Tree."	The entire Colony Mill Road (now a trail) is on the List of Classified Structures.	The General Sherman Tree in Giant Forest grove is the largest tree in the world.	Historic structures include the Southern California Edison flumes and appurtenances.	associated features are eligible for Cultural Landscape designation.	threatened Little Kern golden trout occurs in the Little Kern watershed in the southeastern portion of the unit.
Value 2: Park Developments Dense development characterizes the northern segment of the FMU (Grant Grove) including three campgrounds, NPS employee housing, 100+ private homes in the Wilsonia community, 50+ overnight lodging rooms, a market, restaurant, visitor center, and other visitor support facilities. The southern segment of the FMU (Redwood Mountain) contains a few administrative developments and extensive tracts of sequoia groves.	Value 2: Park Developments The North Fork is traversed by portions of the primary park road (Generals Highway) as well as the Crystal Cave Road. Other than the heavily traveled Generals Highway the unit has few developments. The seasonally operated Dorst Campground and Crystal Cave comprise the primary focal points for visitor use within the unit.	Value 2: Park Developments Most Sequoia National Park developments are in the Marble Fork Unit. These include 2 campgrounds, 2 visitor centers, General Sherman Tree parking and associated developments, the Wuksachi Lodge development, park housing, and a significant commercial center at Lodgepole operated by the park concession. The Generals Highway bisects the unit, and a significant portion of the Crystal Cave road traverses the western end of the Marble Fork FMU.	Value 2: Park Developments Park developments in the Middle Fork are clustered primarily along the Generals Highway road corridor. They include park headquarters, administrative pastures, employee housing, a picnic area, and one campground. A significant exception to developments being associated with the road corridor is the Bearpaw backcountry camp located deep in the Middle Fork wilderness and far from any road. This development (including an NPS campground and concession facility) may house 50 or more visitors and employees during the summer months, with no ready means of escape in case of wildfire.	The East Fork contains several private inholdings and communities, as well as 2 campgrounds and numerous administrative developments. The seasonally occupied private cabins are primarily clustered in five different locations throughout the south aspect of the watershed. They range from small rustic cabins to at least one home valued at over 1.5 million dollars. Administrative developments include stables, employee housing, maintenance shops, and a visitor contact station.	Value 2: Park Developments Few developments occur in this unit, limited to one rustic campground and a short segment of road leading in from the west. Dillonwood, an addition to the park in 2001, also has several buildings and a network of logging roads that provide access into that area from the south.
Value 3: Vegetation Vegetation is more homogeneous than other FMUs in the Kaweah Zone,	Value 3: Vegetation This unit has high diversity in vegetation, containing 11 of the parks' 12	Value 3: Vegetation This unit is similar to the North Fork FMU in vegetation composition,	Value 3: Vegetation Vegetation in the Middle Fork unit is diverse, containing all 12	Value 3: Vegetation Vegetation in the East Fork unit is diverse, containing all twelve vegetation	Value 3: Vegetation The South Fork unit also contains all 12 vegetation communities, including the

Kaweah Zone					
Grant Grove FMU	North Fork FMU	Marble Fork FMU	Middle Fork FMU	East Fork FMU	South Fork FMU
containing only eight of the parks 12 vegetation communities. It is dominated by mixed conifer forest (68% of vegetated area) with significant tracts of ponderosa pine forest and mid-elevation hardwood. The FMU also contains four giant sequoia grove complexes totaling 2,509 acres, proportionately the highest percentage of sequoia acres of all FMUs in the parks (17% of all Grant FMU acres).	vegetation types. Unit acres are dominated by foothill chaparral at lower elevations, followed by roughly equal components of foothills hardwoods, ponderosa pine forest, and white fir-mixed conifer as elevation increases. It is missing only the subalpine conifer forest community. Four giant sequoia groves occur in the unit over a total of 387 acres.	including all twelve vegetation communities found in the parks (though the subalpine component is extremely small). It is dominated by a combination of white fir-mixed conifer and red fir forest, with significant components of ponderosa pine and lodgepole forest. Giant sequoia groves occur on 1,500 acres in two groves. This unit includes most of the Giant Forest grove. The entire Giant Forest grove is functionally managed as part of the Marble Fork FMU.	vegetation community types found in the parks. It is dominated by low elevation foothill chaparral and hardwoods, with a significant component of white fir-mixed conifer forest at the mid-elevations. It contains 4 sequoia groves covering 1,424 acres including a portion of the Giant Forest grove, though that grove is functionally managed as part of the Marble Fork FMU.	community types found in the parks. It is dominated by the higher elevation red fir forest, as well as a significant component of white fir-mixed conifer. The unit contains eight giant sequoia groves totaling 2,455 acres. It includes one grove, Atwell, which had been partially logged in the late 19th century.	largest number of sequoia acres of all park FMUs. It is dominated by red fir forest (27% of vegetated acres) with significant components of white fir-mixed conifer and lodgepole pine forest. With the recent addition of Dillonwood grove to the park, the unit contains approx. 3,100 acres of giant sequoias across 12 groves.
Value 4: Private Lands Inside the Parks Wilsonia is a defined community with an intermix of over 100 privately owned and NPS tracts. Cabins are primarily seasonal summer use, though a few are occupied year-round.	Value 4: Private Lands Inside the Parks None	Value 4: Private Lands Inside the Parks None	Value 4: Private Lands Inside the Parks None	Value 4: Private Lands Inside the Parks The East Fork contains substantial numbers of private lands and leasehold properties scattered throughout the drainage. Most are arranged in a wildland urban interface configuration and require pro-active management of fuels to afford protection. The properties are: Oriole Lake (privately owned – approximately 7 properties) Silver City (privately owned – approximately 50 properties) Kaweah Han (privately owned – single owner) Mineral King developed areas (mix of private lands	Value 4: Private Lands None

Kaweah Zone					
Grant Grove FMU	North Fork FMU	Marble Fork FMU	Middle Fork FMU	East Fork FMU	South Fork FMU
				[2 Disney properties], and 40-60 leasehold cabin sites on public lands)	
Value 5: Cultural Resources All areas of the parks may contain unknown surface and sub-surface archeological resources. Since it is impractical to survey 100% of park lands for potential resources prior to ignition, and since fire has the potential to affect all vegetated parklands, protections for detecting and mitigating unknown archeological resources are built into individual project planning documents and standard operating procedures. Significant known archeological and historic resources will be protected from fire damage to the extent feasible given firefighter safety concerns. Due to the sensitive nature of known archeological site information, park cultural resource staff will be consulted on a project-by-project basis and protection of known cultural resources will be built into each project plan as required by the park archeologist. While some known historic resources that may likely interact with fire management actions are listed by FMU below (non-sensitive information), others may yet be unlisted or their status may change over time. When planning projects, also refer to the List of Classified Structures (LCS) and the list of designated and proposed historic districts and landscapes in Appendix H for further information. See also the list of park protected giant sequoia trees and features listed in Chapter 5 of this plan.					
General Grant National Park Historic District (Proposed) Wilsonia National Historic District 5 buildings on the List of Classified Structures (LCS)	Crystal Cave - trail, gate, generator house (LCS) Cabin Creek structures (LCS) Lost Grove Comfort Station (LCS) Colony Mill road (LCS)	Moro Rock Stairway (LCS) Tharps Log (LCS) Squatters Cabin (LCS) Cattle Cabin (LCS) District Ranger Residence #55 (LCS)	Ash Mountain Historic District (Proposed) Sycamore Historic District (Proposed) Redwood Meadow Ranger Station and out buildings (LCS)	Mineral King Road Cultural Landscape District (Eligible) Hockett Meadow Ranger Station (LCS)	Quinn Ranger Station (LCS)
Value 6: Boundary Interface & Local Community Issues The FMU shares 1.6 miles of its 28 mile external boundary with the State of California at Whitaker Forest, and one mile of boundary is shared with the privately owned Sequoia Lake facility for a total of 2.6 miles of boundary. The remaining external boundary is shared with the USFS Giant Sequoia National Monument and Sequoia National Park. An additional 2 miles of	Value 6: Boundary Interface & Local Community Issues The North Fork FMU shares over 19 miles of external boundary with a mix of other public (15 miles) and private lands (4 miles). The approximate breakdown is: 4.6 miles – USFS Jennie Lakes Wilderness 2.8 miles - Giant Sequoia National Monument 7.8 miles – Bureau of Land Management 4 miles – Private lands	Value 6: Boundary Interface & Local Community Issues This unit shares only a small amount of its perimeter, about 0.5 miles, with the USFS Jennie Lakes wilderness. The remainder of the boundary is surrounded by parklands. Proper smoke management is a consideration for operations in this unit, as the Marble Fork drains into the Middle Fork of the Kaweah and may affect park housing areas at Ash Mountain, or the	Value 6: Boundary Interface & Local Community Issues The Middle Fork FMU shares 5.7 miles of boundary with the Bureau of Land Management and 3.1 miles of boundary with private lands. The Middle Fork presents the most challenging area for smoke management. The deep wide valley surrounded by high elevations ridges and peaks has only one narrow outlet. Under less than optimal conditions, the valley tends	Value 6: Boundary Interface & Local Community Issues The East Fork shares 9 miles of external boundary with other agencies and private landowners. Three miles of boundary are adjacent to the USFS Golden Trout wilderness, and additional 3.5 miles are shared with the Bureau of Land Management, and the remaining 2.5 miles are shared with private landowners. An additional 4 miles	Value 6: Boundary Interface & Local Community Issues The South Fork FMU has the greatest exposure of external boundary of all Kaweah Zone units. It has over 30 miles of boundary shared with: 4.6 miles – USFS Golden Trout Wilderness 10.2 miles – Giant Sequoia National Monument 7.8 miles – Bureau of Land Management 4 miles – Privately owned lands

Kaweah Zone					
Grant Grove FMU	North Fork FMU	Marble Fork FMU	Middle Fork FMU	East Fork FMU	South Fork FMU
internal boundary separates the Wilsonia community from public parklands. Proper smoke management is a critical concern, especially at night when smoke may pool down-slope in and around the Sequoia Lake and Hume Lake developments outside the park. Smoke may also drain northward into the South Fork Kings drainage, affecting visitors and concession facilities (Kings Canyon Lodge on the USFS Hume Lake district, and Cedar Grove developments in Kings Canyon NP.) Emergency closures and extreme smoke events may affect local businesses.	Proper smoke management is a large consideration as the North Fork drains directly into the Three Rivers community, and may result in some smoke pooling in that community at night. Emergency road and facility closures and extreme smoke events may affect local businesses.	community of Three Rivers under extreme conditions.	to accumulate smoke which may drain down valley at night – carrying smoke into populated areas such as the park housing area at Ash Mountain, and the community of Three Rivers. As Three Rivers is a primary gateway community for park visitors, emergency road and facility closures as a result of fire operations, events may affect local businesses. Extreme smoke events may result in fewer visitors visiting the area or reducing their stay – with the potential to affect local businesses.	(approximate) of boundary separates parklands from privately held lands inside the unit. Proper smoke management is a consideration for all operations in this unit, as the East Fork drains directly into the community of Three Rivers. Due to topography and distance, smoke is less prone to pool in this drainage, and concentrated nighttime smoke movement into populated areas outside of the parks is rare. Emergency road and facility closures during the peak visitor season or extreme smoke events may affect local businesses.	Proper smoke management is a consideration for fire operations in this unit, as the South Fork drains directly into the community of Three Rivers. Due to topography and distance, smoke is less prone to pool in this drainage, and concentrated nighttime smoke movement into populated areas outside of the parks is rare. Emergency closures during the peak visitor season or extreme smoke events may have a slight affect on local businesses.
Hazards The Grant unit has the largest departure from desired conditions of all the FMUs in the parks. Fully 57% of all acres in the FMU are in the high or extreme FRID classes, which combined with the dominance of mixed conifer fuel models (37% of acres in FM-10); indicate high fuel loads across most areas. Added to already high fuel loads, mortality in white fir resulting from the 1998-2000 Douglas fir tussock	Hazards The North Fork has the second most altered fuel conditions in the park. Fully 48% of the unit's acres show high or extreme departure from desired conditions. Twenty percent of North Fork acres are in fuel model 10, indicating high fuel loads across much of the unit. Given the dominance of high deviation from natural conditions and the high percentage of the unit consisting of more flammable low elevation	Hazards The Marble Fork unit has 19% of its acres in a high or extreme FRID class. This is the lowest amount in the Kaweah Zone, and can be partially attributed to the pro-active prescribed fire and fuels management focus this area has received over the past 30 years. Approximately 20% of the acres are in fuel model 10, with the bulk of the remaining acres in high elevation mixed conifer, somewhat similar to a fuel model 8.	Hazards Twenty-four percent of the acres in this unit are in a high or extreme FRID class. Wildfires and wildland use fires account for much of the activity that has maintained the unit in the past, though significant portions were also burned in prescribed fires in the late 1970s and early 1980s. High fuel loads associated with fuel model 10 accounts for only 11% of the acres in the Middle Fork.	Hazards Similar to the Middle Fork FMU, 25% of East Fork acres are in a high or extreme FRID class. Numerous prescribed fires in this unit since 1995 have contributed to significantly lower fuel loads across critical areas necessary to protecting park developments and private inholdings. High fuel loads associated with fuel model 10 accounts for only 15% of the acres in the East Fork.	Hazards Nearly 35% of the acres in the South Fork are in a high or extreme FRID class. High fuel loads associated with fuel model 10 account for about 21% of the acres in the South Fork. Fuel loads in the recently acquired Dillonwood grove are unknown at this time, though they may be substantial due to past logging activity. Fuels are continuous within and across park boundaries with few natural boundaries to retard

Kaweah Zone					
Grant Grove FMU	North Fork FMU	Marble Fork FMU	Middle Fork FMU	East Fork FMU	South Fork FMU
moth outbreak created a significant new increment in fuel load across much of the FMU. Fuels are continuous within and across park boundaries with few natural boundaries to retard spread. There is high exposure of this unit to external boundaries and ignition sources. Fuel loads are generally unnaturally high across the unit. Developments are generally situated mid-slope with heavy fuels and potential ignition sources below. The northern portion of the unit is extensively road allowing ready access and providing some man-made holding boundaries. The southern portion of the unit has road access along the eastern boundary and is bisected by a rough dirt road, making the interior less accessible with few natural holding boundaries. Steep west aspect slopes leading into mid-slope developed areas and across boundaries are exposed to full solar radiation during the burn period.	fuel types (chaparral and foothills hardwoods) this unit presents significant challenges to pro-active fuels management. In addition to high fuel loads, there is a high degree of continuity between flashy and highly flammable chaparral and foothills and mid-elevation conifer forests. Few effective natural or man-made barriers to fire spread exist. The unit has a high exposure to external boundaries including private lands. Road access is limited. Due to prevailing west aspect and low elevation component, the unit receives full solar radiation throughout the burn period. The terrain is generally steep and rugged.	Vegetation communities dominating this unit consist of those showing moderate to frequent natural fire return intervals, so consistent attention is needed to maintain and improve conditions.	Difficult access and smoke dispersal issues make pro-active fuels management challenging in this unit.		spread. There is high exposure of this unit to external boundaries and ignition sources.
Risks	Risks	Risks	Risks	Risks	Risks

Kaweah Zone					
Grant Grove FMU	North Fork FMU	Marble Fork FMU	Middle Fork FMU	East Fork FMU	South Fork FMU
Analysis of past human-caused ignitions shows the Grant FMU having the highest incidence of human caused ignitions in the parks. This is primarily due to dense development, an extensive trail network, and highways through and around the unit. The unit averages 2-4 lightning ignitions per square mile over the 35-year analysis period).	Human ignitions in the North Fork FMU are rare, and generally clustered around developments such as Dorst Campground and the Generals Highway. A low level of lightning ignitions occur in this unit (<2 per square mile over 35-year analysis period), with the highest lightning ignition densities in the elevations above 6,000 feet.	The Marble Fork FMU has the second highest rate of human-caused ignitions in the parks concentrated around developments and roadways. Extensive visitor facilities (especially campgrounds) and administrative developments, roads, and trails account for the higher level of human activity and associated ignitions in this unit. A moderate level of lightning activity occurs in the higher elevations (above 6,000 feet) of this unit, focused on the Silliman Divide, with some lightning ignitions reported in the mid-elevations (4,000-6,000 feet)	Human ignitions in the Middle Fork FMU are focused primarily around the Generals Highway corridor where overheated vehicles are a source of frequent ignition. Recreational use along the lower reaches of the Middle Fork Kaweah also contributes human ignitions in this unit. Lightning ignitions occur at a low to moderate rate primarily following the mid-elevation ridges.	A relatively low rate of human ignitions occurs in the East Fork despite a steep winding road through the unit and numerous campgrounds. Lightning ignitions occur at a moderate to high rate along mid-elevation ridges and on the Hockett Plateau.	Few human caused ignitions have been recorded in the South Fork unit over the past 35 years, though the potential certainly exists. The presence of a campground and hiking trails at low elevations, combined with steep terrain and flashy fuels present significant potential. Lightning ignitions occur at a moderate to high rate, primarily along mid-elevation ridges.
Actions Common to all Fire Management Units Human caused fires – other than those intentionally set by NPS staff or park residents under an approved burn plan or permit – will be suppressed under strategies (confine, contain, control) commensurate with firefighter safety and consideration for resource protection from suppression actions.					
Multi-Year Projects and Actions Prescribed fire will be used as the primary tool to fully restore and maintain fuel conditions and ecological function on all undeveloped sites. Treatments will be planned and scheduled to maintain the FMU within the range of natural variability. Mechanical fuel treatments	Multi-Year Projects and Actions At mid and low elevations, prescribed fire will be used as the primary tool to restore and maintain fuel conditions and ecological function. Treatments will be planned and scheduled to maintain the FMU within the range of natural variability. Mechanical fuel treatments	Multi-Year Projects and Actions Prescribed fire and use of wildland fire will be the primary tools used to restore and maintain ecosystem and hazard fuel conditions within acceptable standards in this unit. Mechanical fuel treatments may also be used in areas adjacent to developments	Multi-Year Projects and Actions Prescribed fire and use of wildland fire will be the primary tools used to restore and maintain ecosystem and hazard fuel conditions within acceptable standards in this unit. Mechanical fuel treatments may also be used in areas adjacent to developments	Multi-Year Projects and Actions Prescribed fire and use of wildland fire will be the primary tools used to restore and maintain ecosystem and hazard fuel conditions within acceptable standards in this unit. Mechanical fuel treatments may also be used in areas adjacent to private lands	Multi-Year Projects and Actions Prescribed fire and use of wildland fire will be the primary tools used to restore and maintain ecosystem and hazard fuel conditions within acceptable standards in this unit. Mechanical fuel treatments will be used adjacent to NPS developed areas to

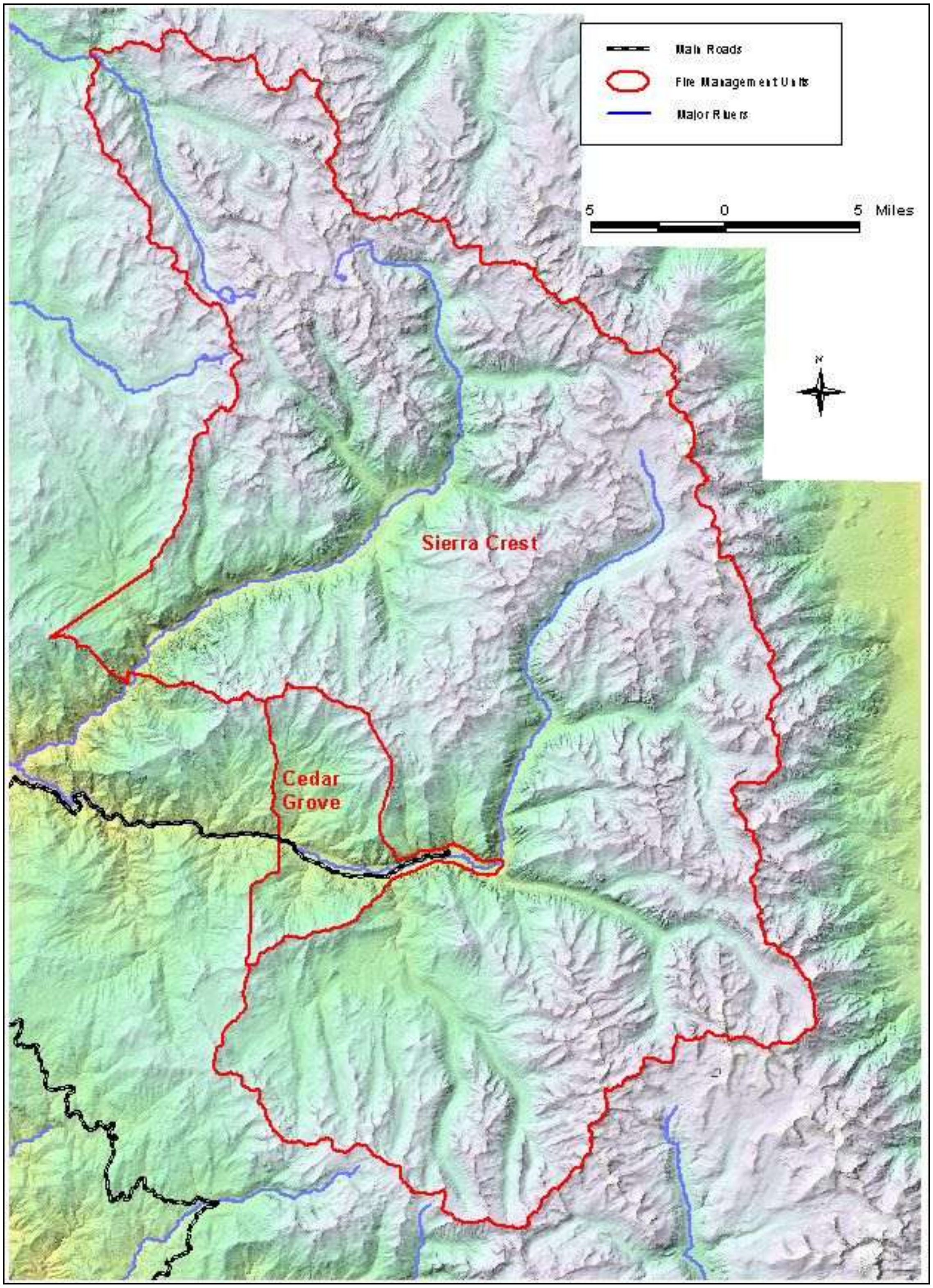
Kaweah Zone					
Grant Grove FMU	North Fork FMU	Marble Fork FMU	Middle Fork FMU	East Fork FMU	South Fork FMU
will be used throughout the NPS developed area to reduce fuels, including NPS lands within and around the Wilsonia community. A 200-foot buffer out from developments will be established and maintained. Treatments will be designed to mimic natural forest structure and composition, and will be repeated every 5-15 years as necessary to maintain fire-safe conditions. Mechanical treatments may also be employed along the park boundary where the use of prescribed fire alone will constitute an unacceptably high risk to non-park lands or values. When adjoining agency implementation timeframes and management objectives coincide with the parks, fuels projects will be implemented across boundaries on an interagency basis. Use of wildland fire may be considered throughout the unit in places and at times of year that will not pose an unacceptable risk to FMU values. Research burns in portions of the Redwood Mountain grove may be implemented as part of a larger study plan in cooperation with adjacent agencies. The Redwood Mountain grove,	will be used throughout and surrounding the NPS developed areas to reduce fuels. A 200-foot buffer out from developments will be established and maintained. Treatments will be designed to mimic natural forest structure and composition, and will be repeated every 5-15 years as necessary to maintain fire-safe conditions. Mechanical treatments may also be employed along the park boundary where the use of prescribed fire alone will constitute an unacceptably high risk to non-park lands or values. When adjoining agency implementation timeframes and management objectives coincide with the parks, fuels projects will be implemented across boundaries on an interagency basis. Use of wildland fire may be considered throughout the unit in places and at times of year that will not pose an unacceptable risk to FMU values. Due to the lack of accessibility and absence of natural or man-made boundaries in this unit, the park acknowledges that wildfires may be difficult to	and roads. A 200-foot buffer out from developments may be established and maintained. Mechanical treatments will be designed to mimic natural forest structure and composition, and will be repeated every 5-15 years as necessary to maintain fire-safe conditions. Use of wildland fire may be considered throughout the unit in places and at times of year that will not pose an unacceptable risk to FMU values.	and roads. A 200-foot buffer out from developments may be established and maintained. Mechanical treatments will be designed to mimic natural forest structure and composition, and will be repeated every 5-15 years as necessary to maintain fire-safe conditions. Use of wildland fire may be considered throughout the unit in places and at times of year that will not pose an unacceptable risk to FMU values	and public developments and roads. A 200-foot buffer out from developments may be established and maintained. Mechanical treatments will be designed to mimic natural forest structure and composition, and will be repeated every 5-15 years as necessary to maintain fire-safe conditions. Use of wildland fire may be considered throughout the unit in places and at times of year that will not pose an unacceptable risk to FMU values	reduce fuels. A 200-foot buffer out from developments will be established and maintained. Treatments will be designed to mimic natural forest structure and composition, and will be repeated every 5-15 years as necessary to maintain fire-safe conditions. Mechanical treatments may also be employed along the park boundary where the use of prescribed fire alone will constitute an unacceptably high risk to non-park lands or values. When adjoining agency implementation timeframes and management objectives coincide with the parks, fuels projects will be implemented across boundaries on an interagency basis. Use of wildland fire may be considered throughout the unit in places and at times of year that will not pose an unacceptable risk to FMU values. Research burns in portions of the Dillonwood grove may be implemented under approved study plans.

Kaweah Zone					
Grant Grove FMU	North Fork FMU	Marble Fork FMU	Middle Fork FMU	East Fork FMU	South Fork FMU
with portions managed by three different agencies, provides an ideal place to conduct research comparing different management strategies for giant sequoia. In the 1960s Redwood Mountain was the location of significant research documenting the role of fire in giant sequoia systems.	manage or contain within this unit. As a result, aggressive initial action consistent with firefighter safety will be a high probability for starts below 5,000' elevation. Fires that escape initial action at lower elevations are likely to grow large until intercepting significant natural or man-made boundaries.				
Further Compliance Needs The scope of proposed actions and their expected effects are thoroughly assessed in the companion Environmental Assessment (EA). All mitigating actions contained in the EA will be implemented for projects conducted in this unit. Cultural resource consultation with the park archeologist will take place during the planning phase for all projects. In addition, mechanical fuel projects will require consultation with park wildlife and plant ecologists during the planning phase to ensure adequate protection for site specific species. Other than actions noted above or as contained in the EA, no additional environmental compliance will be required for projects	Further Compliance Needs The scope of proposed actions and their expected effects are thoroughly assessed in the companion Environmental Assessment (EA). All mitigating actions contained in the EA will be implemented for projects conducted in this unit. Cultural resource consultation with the park archeologist will take place during the planning phase for all projects. In addition, mechanical fuel projects will require consultation with park wildlife and plant ecologists during the planning phase to ensure adequate protection for site specific species. Other than actions noted above or as contained in the EA, no additional environmental compliance	Further Compliance Needs The scope of proposed actions and their expected effects are thoroughly assessed in the companion Environmental Assessment (EA). All mitigating actions contained in the EA will be implemented for projects conducted in this unit. Cultural resource consultation with the park archeologist will take place during the planning phase for all projects. In addition, mechanical fuel projects will require consultation with park wildlife and plant ecologists during the planning phase to ensure adequate protection for site specific species. Other than actions noted above or as contained in the EA, no additional environmental compliance	Further Compliance Needs The scope of proposed actions and their expected effects are thoroughly assessed in the companion Environmental Assessment (EA). All mitigating actions contained in the EA will be implemented for projects conducted in this unit. Cultural resource consultation with the park archeologist will take place during the planning phase for all projects. In addition, mechanical fuel projects will require consultation with park wildlife and plant ecologists during the planning phase to ensure adequate protection for site specific species. Other than actions noted above or as contained in the EA, no additional environmental compliance	Further Compliance Needs The scope of proposed actions and their expected effects are thoroughly assessed in the companion Environmental Assessment (EA). All mitigating actions contained in the EA will be implemented for projects conducted in this unit. Cultural resource consultation with the park archeologist will take place during the planning phase for all projects. In addition, mechanical fuel projects will require consultation with park wildlife and plant ecologists during the planning phase to ensure adequate protection for site specific species. Other than actions noted above or as contained in the EA, no additional environmental compliance	Further Compliance Needs The scope of proposed actions and their expected effects are thoroughly assessed in the companion Environmental Assessment (EA). All mitigating actions contained in the EA will be implemented for projects conducted in this unit. Cultural resource consultation with the park archeologist will take place during the planning phase for all projects. In addition, mechanical fuel projects will require consultation with park wildlife and plant ecologists during the planning phase to ensure adequate protection for site specific species. Other than actions noted above or as contained in the EA, no additional environmental compliance

Kaweah Zone					
Grant Grove FMU	North Fork FMU	Marble Fork FMU	Middle Fork FMU	East Fork FMU	South Fork FMU
that fall within the scope of projects and effects described in the EA.	will be required for projects that fall within the scope of projects and effects described in the EA.	will be required for projects that fall within the scope of projects and effects described in the EA.	will be required for projects that fall within the scope of projects and effects described in the EA.	will be required for projects that fall within the scope of projects and effects described in the EA.	will be required for projects that fall within the scope of projects and effects described in the EA.

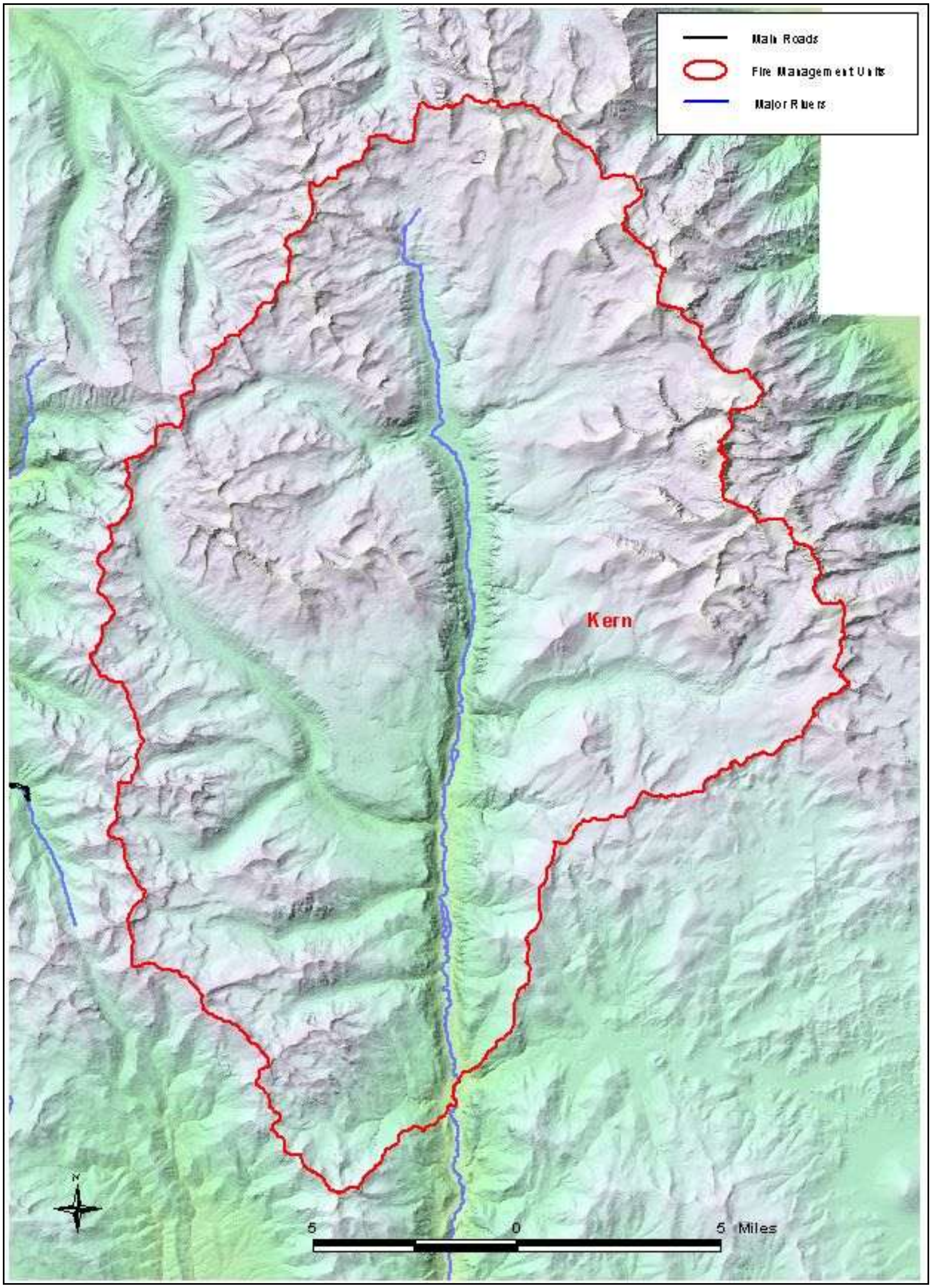
Note: The Kings Zone has only two FMUs, called the Sierra Crest FMU and Cedar Grove FMU.

Figure 4-7: Map of Kings Zone Fire Management Units (FMUs)



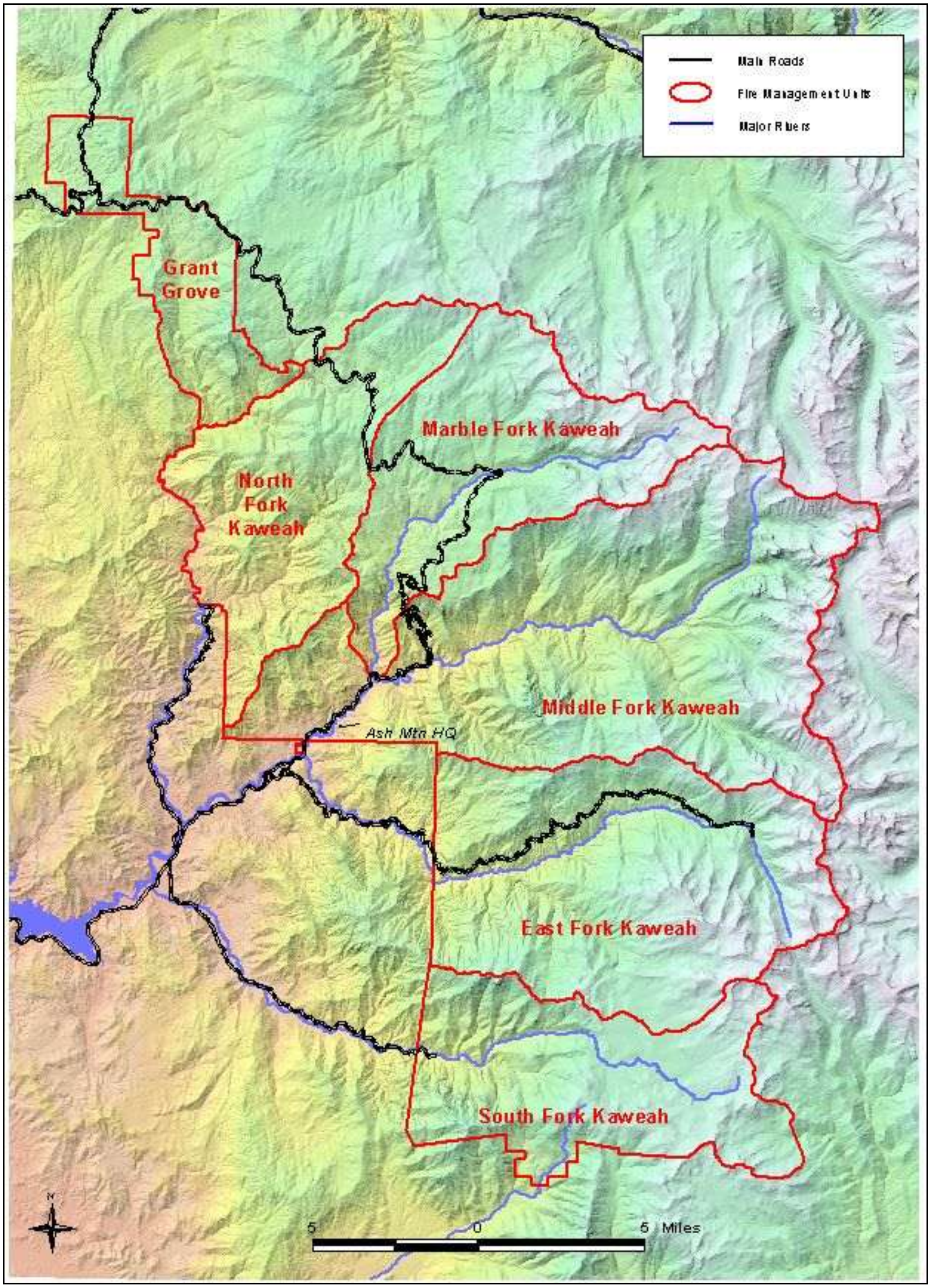
Note: The Kern Zone has only one FMU, called the Kern FMU.

Figure 4-8: Map of Kern Zone Fire Management Units (FMUs)



Note: The Kaweah Zone has six FMU's labeled in red below

Figure 4-9: Map of Kaweah Zone Fire Management Units (FMUs)



5. Protection of Sensitive Values

GIANT SEQUOIA ISSUES: MANAGEMENT AND PROTECTION

Thirty-nine giant sequoia groves (11,417 acres) exist as enclaves in the mixed conifer forest within the two parks. In the early years of the parks' history, management made every attempt to exclude fire from the groves. After ~75 years of fire suppression, the loss of fire as a keystone ecological influence produced "unnatural fuel conditions" and changed the forest structure of the groves. Additionally, research linked fire exclusion to the dramatic decline in sequoia germination and recruitment.

In the late 1960s, the parks developed a prescribed fire program to reverse these effects. Fire management objectives focused on fuel reduction and seedbed preparation to promote sequoia reproduction. Prescriptions used during restoration burns generally produced a low intensity fire by compensating for "unnaturally heavy fuels" with conservative firing techniques, timing, and weather.

In general, the parks' sequoia groves will not be treated differently from the white fir/mixed conifer forest. The sequoia groves will be managed as ecosystems with natural processes, not collections of individual trees. However, this chapter discusses two exceptions to this practice where Special Management Areas and Trees of Special Interest (defined below) are given extra attention in relation to fire. The parks will continue to use fire as a management tool; however, care will be taken to minimize the effects of fire on these special areas.

Special Management Areas (SMAs)

Special Management Areas (SMAs) are designed to balance natural process restoration with the need to preserve the important scenic value of the forest in heavily-used portions of groves where there are large numbers of visitors or developments. SMAs will be maintained as features with a managed landscape based on historical appearance.

SMA protection does not exclude fire management activities. In these areas, prescribed burning can be done on a small scale to provide for public safety, and to prevent sudden, large-scale scenic changes. Fire management staff will consider prescribed burn unit size, the location of subsequent prescribed burns, and the protection of various scenic resources when planning projects in SMAs. Specific objectives and techniques are outlined later in this chapter.

The parks have two designated SMAs: the 22-acre Grant Tree SMA (Figure 5-1) and the 15.6-acre Sherman Tree SMA (Figure 5-2). Both areas are defined by previous park documents. The Grant Tree SMA was described in Effect of Past Management Actions on the Composition and Structure of Vegetation in the Grant Tree Portion of Grant Grove (Kauper et al 1980). The Sherman Tree SMA was identified in Special Management Area Visual Resources Management Study for the Sequoia National Park Prescribed Fire Management Program (Dawson 1987). This SMA was reconfigured in 2013 because of substantial changes to trail and road footprints that that resulted in significant changes in use patterns and, therefore, viewshed for visitors.

Figure 5-1: Grant Tree Special Management Area

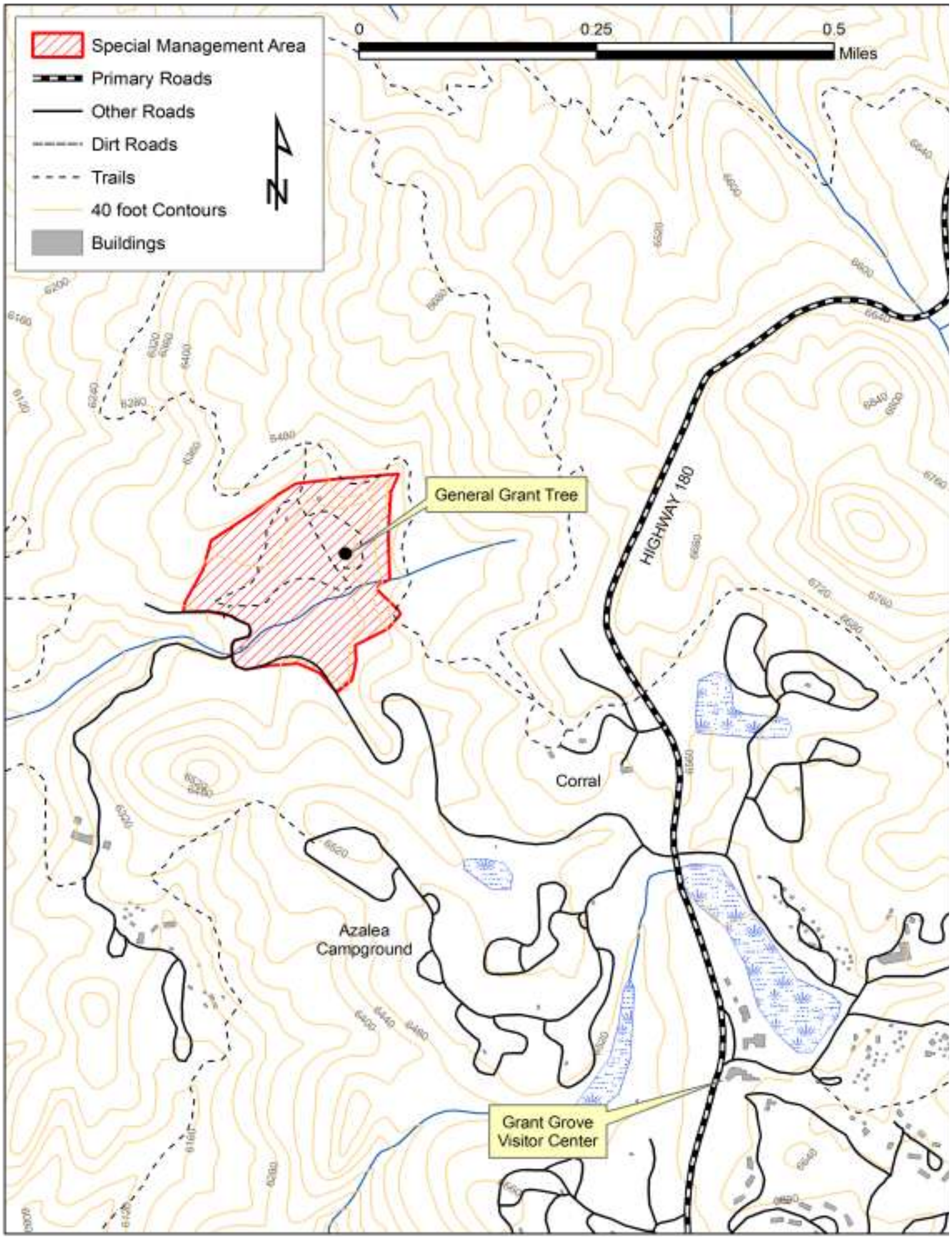
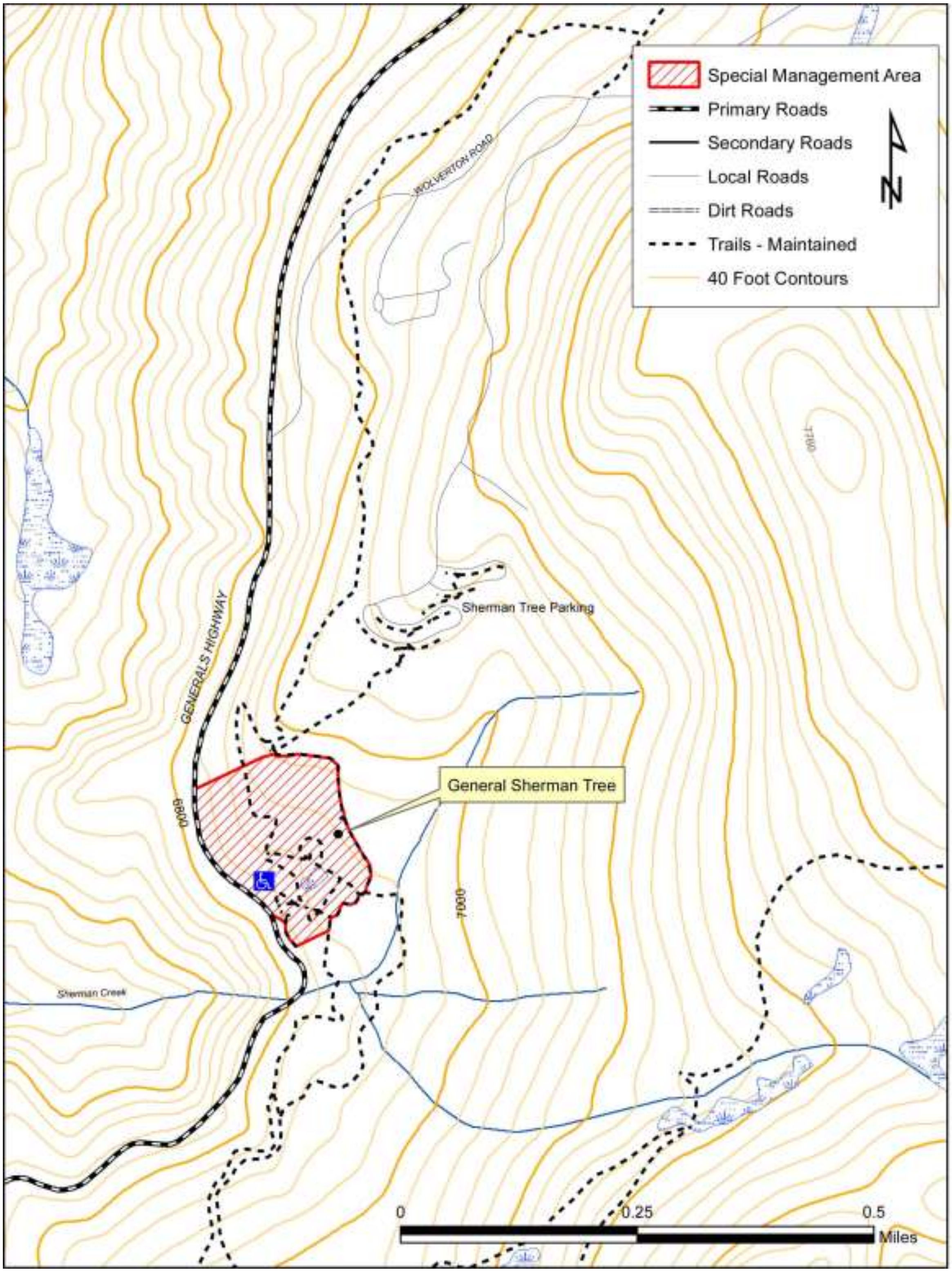


Figure 5-2: Sherman Tree Special Management Area



TREES OF SPECIAL INTEREST

Purpose

The Fire and Fuels Management Plan for Sequoia and Kings Canyon National Parks provides guidance for the protection and management of trees of special interest as a part of the parks' fire management program. Other park programs also provide special protection to this category of trees. The category "trees of special interest" includes standing trees, groups of standing trees, and tree-related objects (dead snags, down logs, and stumps). The purpose of providing special management to these trees is to increase the likelihood that natural objects of emotional importance to park visitors survive for future enjoyment. Realizing that, being organic objects, they will eventually die or decay.

The protection of trees of special interest (referred to "named trees" on occasion for readability) does not exclude fire management activities. The parks will use appropriate techniques (listed later in this chapter) to protect these trees from fire. However, it must be understood that sequoia groves are natural systems and, despite the parks' best efforts and/or actions, fire may affect a tree of special interest.

Background

Giant sequoias as a species are of considerable social value. The creation of these parks and the National Park Service is due, in part, for the fight to protect the much loved giant sequoias from logging. One of the purposes of the parks is to protect the greater Sierran ecosystem — including the giant sequoia groves — and its natural evolution. But from an ecological perspective, one giant sequoia has essentially the same value as any other. Placing a name on a giant sequoia (or designating it as a tree of special interest) does not make it more significantly ecologically.

Trees of special interest are giant sequoias that are significant because of the attention they receive from park visitors. This designation is based primarily on social criteria. These trees (including groups of trees, and tree-related objects as defined above) have captured human interest over time and have generally been recognized with individual names or some other form of special identification.

Cultural Resources

Social significance is distinctly different from cultural significance. The only culturally significant giant sequoia trees are those that have been evaluated against National Register criteria, deemed significant, and therefore listed on the park's List of Classified Structures (Appendix H). The protection and management of LCS structures is outside the scope of the "trees of special interest."

Criteria for Trees of Special Interest

Trees of special interest are standing giant sequoia trees (Sequoiadendron giganteum), groups of giant sequoia trees, dead giant sequoia snags, down giant sequoia logs, or giant sequoia stumps. The trees listed in Table 5-1 meet one or more of the following criteria:

- Identified by name on an official park "map and guide" issued since 1980.

- Identified by name within the official trail map series issued by the Sequoia Natural History Association. (The trail maps for Giant Forest and Grant Grove identify specific named trees.)
- Identified by name within the Congress Trail and Grant Tree Trail brochures issued by the Sequoia Natural History Association.
- Identified by name by official NPS-erected signs at some time since 1980.
- Identified by name by official NPS-erected wayside exhibits at some time since 1980.
- Identified as one of the forty largest giant sequoia trees in the world as listed in Flint and Law, To Find the Biggest Tree, Sequoia Natural History Association, 2002. Such trees are sometimes not named or are not clearly named (e.g., "Unnamed tree near Ed by Ned").
- Incorporated as a design element of a designated trail (for example, a log that serves as a bridge, or a log with a pedestrian tunnel). Such trees are sometimes not named or are not clearly named (e.g., "unnamed tunnel log on Congress Trail").

It is recognized that the Trees of Special Interest list is not static. From time to time, it may become advisable to add or subtract trees from this list. Such changes will be made through update and replacement of the Policy Statement Defining "Trees of Special Interest." This document is located here: J:\seki\park_programs\share_docs\fire\FIO.

Responsibilities

The Chief Ranger and the Chief of Resources Management and Science will jointly ensure that the trees of special interest listed in Table 5-3 are managed under the procedures specified in this plan. This includes ensuring that burn plans identify appropriate protection measures for any trees of special interest that occur within the burn unit.

The Chief of Resources Management and Science will ensure that an up-to-date GIS layer of the trees of special interest is maintained.

The Chief of Resources Management and Science will ensure that an up-to-date cultural resources GIS layer (including any giant sequoias which are on the LCS) is maintained. Giant sequoias will be formally evaluated against National Register criteria when appropriate. Trees found to be eligible through this evaluation process will be included on the LCS and in the GIS layer.

The park-wide policy regarding Trees of Special Interest is contained in a park-wide document called Policy Statement Defining "Trees of Special Interest" dated March 2, 2007. This park-wide policy statement is an addendum to the FFMP.

Mitigation Measures: Objectives

For SMAs or identified trees of special interest, park management will strive to meet the following objectives during all fires while maintaining firefighter and public safety:

Although SMAs and trees of special interest are fire-adapted, their level of social significance provides a quandary for firefighters. It seems paradoxical that these trees receive protection from fire while conducting a prescribed fire for species health and germination. It is important to note that fire in sequoia groves provides for the species health on a landscape or habitat level although it may not for individual trees that are named. As always, firefighter and public safety are the highest priority.

To provide the greatest level of firefighter safety, a firefighter should look at an SMA or tree(s) of special of interest as something that needs protection from fire; such as structures, developments, cultural resources, or threatened and endangered species; rather than a fire-adapted tree. Reasonable efforts to "prep" an area before a prescribed fire or during wildfire (if possible, if time allows, and if it is safe to do so) to mitigate the risk to the tree(s) from fire should be made.

The Fire Ecologist or his designated Resource Advisor (READ) is responsible for:

- meeting the intent of this policy
- the protection of trees of special interest not only from fire, but also from resource impacts (for example, the root system of the sequoia) that may be potentially incurred during prep.

The Fuels Specialist/Burn Boss or their designee (during a prescribed fire) or Incident Commander (during a wildfire) is responsible for:

- ensuring that prep standards meet firefighter and public safety
- meeting the intent of this policy
- the protection of trees of special interest not only from fire, but also from resource impacts (for example, the root system of the sequoia) that may be potentially incurred during prep.

For a prescribed fire, the Fuels Specialist/Burn Boss and the Fire Ecologist/ designated READ will conduct a site visit during the project planning phase. They will assess the condition of the tree(s), the fuels, location, etc. to determine the prep standards to implement for the tree(s) for the prescribed fire. Adequate time should be allotted for firefighters to complete the prep prior to the day of the prescribed fire. This ensures that the prep standards meet both firefighter safety and resource protection objectives as it relates to trees of special interest.

In the event that fire should spread in a tree of special interest, the prep standards should be such that the visual alteration of the trees approximates the following:

- Strive to prevent excessive bark charring on a tree of special interest: 1) greater than ten feet above the ground, 2) around more than 50 percent of a tree's circumference, 3) on more than 10 percent of trees with a diameter of four feet or greater (at breast height). In certain cases, heavy fuels (e.g. giant sequoia logs at the base of trees) may preclude meeting this objective.
- Strive to prevent no more than 30% of total crown scorch on trees of special interest with a diameter of four feet or greater (at breast height). In certain cases, heavy fuels (e.g. giant sequoia logs at the base of trees) may preclude meeting this objective.
- Strive to prevent the ignition of fire scars on trees of special interest. Should ignition occur during the smoldering stage of a fire, the scar will be extinguished if safe and practical to do so. In addition, steps will be taken to ensure that there is little or no change in visual character of trees in these areas.

Use ignition techniques that will limit torching and spotting from ladder fuels in the vicinity of a tree of special interest or SMA thereby limiting chances of spot fires igniting in the canopies of trees.

However, it should be noted that these prep standards, while being effective for many trees, will be ineffective for others, based upon the condition of the tree. Several named trees have significant weaknesses, such as substantial catfaces (or even a hollowed out or "clothespin" base), snagtops, leans, or are topped. There is little a firefighter can do to limit the visual effect of fire in these trees if fire should spread into these trees. Prep standards, in these cases, should focus on the efforts to effectively exclude fire near these trees.

Mitigation Measures: On-the-Ground Techniques

The following techniques supervised by the Fire Ecologist/designated READ and the Burn Boss/IC, may be used to accomplish the objectives above:

1. <u>Inspecting Fuel Conditions</u> – Prior to the fire, all trees of special interest in the fire area will be inspected for fuel conditions in a buffer zone 20-feet in diameter around the tree's base. If unnatural accumulations of 1,000 hour fuels (three-inch diameter and greater) are found in this buffer, they will be removed.

Giant sequoia logs, single snags near sequoia trunks, debris from a fallen sequoia top or branch, may not in themselves constitute unnaturally heavy fuels, although the tonnage can be enormous. Such fuels can be left in place to burn, but may radically alter the appearance of neighboring giant sequoias. Taking photographs pre- and post-burn in these areas will document the change in fuels. These pictures, along with shots during the burn, will provide important interpretive and documentary tools to display the area's biological and scenic recovery. However, for trees of special interest, a reasonable effort to clear or exclude these fuels should be considered.

If the tree of special interest is on a slope, fuel will be scattered to the sides of the trees. The fuel will not be scattered above or below the trees, if possible. If space is limited, fuel removed from around a tree may be piled in a clearing or opening.

2. <u>Inspecting Crown</u> – Prior to the fire, all trees of special interest in the fire area will be inspected for the probability of ignition in the crown. The probability of ignition in the crown will be considered when choosing operational techniques but will not preclude using fire in the area.

3. <u>Choosing Ignition Distance</u> – When determining the appropriate distance to ignite from the base of a tree of special interest, the tree's fire scars and surrounding fuel loading will be considered. Most often, a six-foot separation will be an appropriate distance.

4. <u>Assessing Need for Fireline</u> – If needed, a fireline may be placed around a tree of special interest if judgment determines the presence of significant fuels that are likely to visually alter or damage a tree of special interest. Generally, such fuels are of larger diameter (>three inch - 1,000-hour fuels) which are principally fallen cedar, fir, and pine trees or unusually heavy litter and duff accumulations. A fireline should not be used if roots deeper than 12" will be

uncovered. Surface litter may also be raked from around a tree. The use of rakelines may also be an option.

5. Using Foam or Water – Foam or water may be applied to the trunk of a tree of special interest or in the exclusion area if accessible by equipment.

In the Event that Fire Starts within or Spreads into a Tree of Special Interest

As stated earlier, it must be understood that sequoia groves are natural systems and, despite the parks' best efforts and/or actions, fire may affect a tree of special interest. In the event that fire does enter a tree of special interest, the prep standards should have been such that significant visual alteration will likely not occur for many of the named trees. Several named trees have significant weaknesses, such as substantial catfaces (or even a hollowed out or "clothespin" base), snagtops, leans, or are topped. There is little a firefighter can do to limit the visual effect of fire in these trees if fire should spread into these trees.

Firefighters need to understand that they do not need to take unnecessary risk or be emotionally vested in keeping fire out of named trees during a fire event. In the event that named trees do get fire in them (or their exclusion area), the Burn Boss/ IC or their designee has the sole authority to determine the course of action for the fire. Designees may include firefighters acting as Holding Boss, modules leads, or single resource qualified firefighters with the experience to make an accurate, safe assessment. Decision points will be established to ensure firefighter safety.

- Any event when fire enters in a tree of special interest, in the exclusion area of a tree of special interest, or when a tree special interest seems threatened by fire must be reported, through the chain of command, to the Burn Boss/IC.
- The Burn Boss/IC will notify Ash Mountain Fire.
- Per the Burn Boss, through his designee (if applicable), firefighters may try to extinguish initial ignitions in or near the trees if it is safe to do so and they see a high probability of success.
- Firefighters will not try to extinguish the fire if it is above them in the trees (if the fire is in canopy or high in the catface, where water use will be ineffective).
- Firefighters will disengage if the fire cannot be safely and quickly extinguished. In the event fire gets established in the tree, firefighters will use a monitoring strategy. Past suppression efforts, including the use of helicopter water drops, in giant sequoias have proven to be generally ineffective.
- Firefighters and Burn Bosses/ ICs or their designees need to recognize if there is mission focus or escalation of commitment to protecting a named tree with fire in it. Firefighters, by their nature, are task –oriented. Mission focus can lead to lost situational awareness and compromise firefighter safety. Clear leaders intent from the parks Leadership Team, the Fire Management Officer, Burn Bosses, ICs and module leaders should help firefighters understand that unsafe, high risk, or otherwise extraordinary efforts to extinguish fires in trees of special interest is not necessary nor desired.
- Burn Boss/ IC will review these standards and their expectations at the operation briefing to ensure clear leader's intent.

OTHER SPECIAL CONSIDERATIONS FOR GIANT SEQUOIA MANAGEMENT

Giant Forest Restoration

Guidelines for the Giant Forest restoration include the use of fire within either the "biological" or "landscape" restoration zones (NPS 1995). Goals and objectives of restoration include the recreation of the structure and composition of vegetation within the natural range of variability if development had not taken place and if fire had not been suppressed. Two fire management options have been defined in the plan:

Fuel Manipulation

The removal of buildings and facilities has left large openings in the forest that are lacking in fuels. Fuels may be hauled onto these restoration areas and burned onsite to create the bare, mineral seedbed which fosters sequoia seedlings. The source of fuel will be adjacent forest areas with excessive amounts of limbs, litter, and duff.

Prescribed Fire

Prescribed fire may be utilized to achieve project goals. Fire modifies the composition and structure of the forest by killing some tree species while giant sequoias are fire resistant and tend to survive. Giant sequoias are also a shade intolerant species in which most successful regeneration occurs in open areas with bare mineral soil that are usually created by fire.

Dillonwood Grove

The addition of a large portion (~1,500 ac) of the Dillonwood giant sequoia grove to the parks occurred in 2001. The grove is located adjacent to Sequoia National Park's south boundary in the North Fork of the Tule River drainage. It has been under private ownership since the late nineteenth century and has experienced extensive logging of giant sequoias through the 1940s and non-sequoia species into the 1980s. Incorporation of this new area into park management will require assessment of the area's natural, scientific, cultural, and historical features and how it should be integrated into fire and fuels management planning. Should the grove's separate planning effort resolve that the area will be managed in accord with the rest of the parks' mixed conifer forest (including the use of fire as a research tool); this Fire and Fuels Management Plan will apply. If the grove planning effort resolves a management direction for Dillonwood that is outside of the treatments covered in this plan and the companion Environmental Assessment (EA), a separate fire planning and compliance effort will take place.

Table 5-1: Trees of Special Interest

Grant Tree Special Management Area			
Grant Grove	Arizona Arkansas California Centennial Stump & Log (stump and down log) Connecticut Dead Giant Delaware Fallen Monarch (down log) Florida General Grant Georgia Idaho	Illinois Indiana Iowa Kentucky Lightning Lincoln Maine Maryland Massachusetts Michigan Log (down log) Minnesota Missouri Nevada	New Jersey New Mexico Ohio Oklahoma Oregon Pennsylvania Robert E. Lee Tennessee The Happy Family (group) The Martyr Twin Sisters Vermont Log (down log) Virginia Wyoming
Sherman Tree Special Management Area			
Giant Forest	General Sherman Unnamed tunnel log on accessible trail to Sherman Tree		
Other Trees of Special Interest			
Giant Forest	Adams Auto Log (down log) Bear's Bathtub Black Arch Black Chamber Booker T. Washington Broken Arrow Burial Buttress (down log) Charles Young Chief Sequoyah Chimney (dead snag) Clara Barton Cleveland Column (Near Pershing) Dead Giant Ed by Ned Founders (group) Four Guardsmen (group)	Franklin General Lee General Pershing Hamilton House (group) Leaning Lincoln McKinley Monroe Parker (group) Pillars of Hercules Puzzle (down log) Room Roosevelt Senate (group) Sentinel Susan B. Anthony The Cloister (group) The President Three Graces	Triple (group) Telescope (dead snag) Tunnel Log (down log) Washington Unnamed tree near Ed by Ned Unnamed tunnel log on Congress Trail lower loop Unnamed tunnel log on Congress Trail upper loop Unnamed tunnel log on Hazelwood Loop Trail Unnamed tree that acts as a bridge over the Little Deer Creek
Big Stump	Burnt Monarch Mark Twain Stump Pattee Trees (group) Sawed Tree Shattered Giant (down log)		
Redwood Canyon	Barton Post Camp (down log) Fallen Goliath Hart Roosevelt (False Hart) Unnamed tunnel log on Hart Tree Trail		
Garfield	King Arthur		
Atwell Grove	AD Dean Diamond		

Cultural Resources

Cultural resources (both prehistoric and historic) may be impacted to varying degrees by fire and fire management actions. Since these resources are located in a highly flammable environment, unwanted fire effects may not be completely preventable under all circumstances. However, impacts may be managed with appropriate pre-planning, avoidance, and mitigation. Mitigation efforts are designed to prevent the impairment of the parks' known cultural resources, and minimize the chance of adverse impact to unknown sites.

Prehistoric Resources

The effects of fire on prehistoric sites are variable, with particular concerns associated with rock art sites and those sites with dense, surface-visible scatters of obsidian. In general such sites, even those with shallowly buried deposits or features, tend not to be impacted adversely by low intensity fires, while high intensity fire events associated with heavy fuel loads may cause serious impacts such as spalling of rock surfaces, the crazing of cherts or obsidian artifacts, the fracturing of ceramics or potsherds, and the disruption of hydration bands on obsidian surfaces.

Of significant concern is the ground disturbance associated with the placement of staging areas and the construction of firelines necessary to fight or manage fires. These actions have the potential to impact prehistoric resources directly through ground disturbance.

Ethnographic Resources

The effects of fire on ethnographic resources are variable and difficult to identify. Sites with fragile archeological features such as pictographs or petroglyphs would be affected similar to prehistoric resources. Sites where traditional access to particular natural resources of cultural significance (such as plants used for craft production or ceremonial purposes) could be affected as a result of fire (e.g., re-growth and health vs. loss or diminution of the plants) and may result in either positive or negative effects.

The loss or reconfiguration of culturally important landscapes or vistas may occur as a result of fire, especially high intensity wildfire.

Historic Resources

The effects of fire on historic era sites are variable. Located in and around developed areas of the parks, there is particular concern associated with wooden buildings and structures, logging debris (e.g., stumps and shake piles), and mining features (e.g., flumes and trestles). Many other sites are effectively sub-surface in their current appearance and thus relatively protected from adverse impact from fires, especially low intensity burns. Of greatest concern is the placement of staging areas and firelines needed to fight or manage fires. Associated ground disturbance has the potential for direct and adverse impacts on historic sites.

Potential Impact Sources

There are three major fire-related factors that can affect the level of impact to cultural resources: disturbance of the ground, the ability to pre-plan and avoid impacts, and the risk posed by high intensity fire events.

Surface Distrubance

Surface disturbance occurs as a result of the need to construct fireline, fire camps, staging areas, and related facilities. Fire management actions that minimize the need for surface disturbance will have less potential to affect cultural resources.

Pre-planning and Avoidance

Pre-planning minimizes potential impacts from fire management actions by allowing consultation and oversight by cultural resource specialists. Tools that rely more heavily on pre-planned fire management actions (such as prescribed fire) allow advance identification and avoidance of significant cultural resources. Conversely alternatives that entail more unplanned or emergency fire events, with little opportunity for advanced planning and clearance for cultural resources, have more potential to impact cultural resources.

High Intensity Fire

High intensity fires have the potential to drive heat pulses deep into the ground and to spall off rock surfaces that may contain rock art. These mechanisms can also negatively affect subsurface and lithic cultural resources. There are opportunities for high intensity fire events in many areas of the parks, though the size and timing of such events vary by alternative. Actions that proactively reduce heavy fuel accumulations through low intensity prescribed fire or through mechanical removal of fuel reduce the risk of damage to cultural resources from high intensity fire.

General Mitigation Process

The parks Cultural Resources Program Manager will review all prescribed burn and mechanical fuel project plans for the presence of known surface resources and shallow subsurface resources in the project area. Combining information on the location and sensitivity of known sites with information on the expected fire operations impacts, fuel loads, and anticipated fire intensity, the Cultural Resources Program Manager will specify requirements necessary for the protection of significant resources within the project area. These requirements will be documented in each individual burn or mechanical fuel treatment plan.

Fireline construction or any other ground disturbing activity planned for prescribed and mechanical fuel projects will be flagged in advance of any work on the ground, and must receive clearance and approval from the park Cultural Resources Program Manager prior to the work.

For unplanned fires, the park Cultural Resources Program Manager will be consulted during the development of the WFDSS. Known significant resources requiring protection will be identified in the planning process, and mitigations specified and documented in the plan and implemented as part of the project.

For unplanned fires, the Cultural Resources Program Manager will be consulted as soon as practical to identify sensitive resources that have the potential to be affected by the fire or by fire management actions. To the extent possible – and considering short timeframes, unpredictable fire behavior, and firefighter and public safety - mitigation measures specified by the Cultural Resources Program Manager will be implemented as part of the suppression response.

Required mitigation in all cases may include but is not limited to: relocation of firelines away from sensitive sites, line construction to exclude sites, removal of fuels from sensitive sites to reduce fire intensity, installation of hoselays, sprinklers or other water handling devices for direct protection of features, and/or wrapping sites or features with fire protective shelter material. As new cultural resource requirements and standards for protection are developed, they will be adopted and included as an appendix in this document.

Assessing the condition of known resources before project implementation and after the project is complete will provide better information on effects on cultural resources, and feedback on the effectiveness of mitigation practices. More detailed cultural resource monitoring information is included in Appendix C.

WILDERNESS

Approximately 93% of the parks are designated wilderness. As of 2012, another 4% of parklands have been proposed for wilderness designation. By NPS policy, areas proposed for wilderness are managed exactly the same as designated wilderness.

NPS Management Policy 6.3.9 directs that:

> "Fire management activities conducted in wilderness areas will conform to the basic purposes of wilderness. The parks' fire management and wilderness plans together will identify the natural and historic roles of fire in the wilderness and will provide a prescription for response to natural and human caused wildfires.
>
> Wildland fire in wilderness will be suppressed when necessary to protect life safety, significant cultural and natural resource values, or to conform to air quality regulatory requirements. Such wildland fire suppression is deemed the minimum requirement.
>
> Actions taken to suppress wildland fire will use the minimum requirement concept and will be conducted in such a way as to protect natural and cultural features and to minimize the lasting impacts of the suppression actions and the fires themselves."

A high value will be placed on continuing to assure preservation of wilderness character.

> NPS Director's Order 41, Wilderness Preservation and Management (DO-41, Section 5) further states that "under ideal conditions, natural fire should be considered as a fundamental component of the wilderness environment."

In conformity with direction in NPS Management Policy 6.3.9 and NPS Director's Order 41, the natural and historic role of fire in the parks' wilderness has been assessed and documented. In summary, lightning ignited fires have been found to be a natural process and primary driver of natural plant communities throughout the parks' wilderness. Native American use has also been documented, with the influence of such use in shaping vegetation communities largely unknown (see Chapter 9).

All fire management activity in wilderness will be conducted according to minimum impact suppression guidelines. Delegations of authority to incoming fire management teams will require that minimum impact suppression techniques be followed.

The use of chainsaws, portable pumps, and the landing of helicopters, for all fire operations will be considered appropriate as the minimum tool, as will electronic devices including but not limited to global positioning units for mapping and locating fires, and cell phones and portable radios for communications.

When using helicopters, the parks will consider operational periods, amount of flight time, and sensitivity of travel routes. When using stock, the parks will adhere to existing park regulations including party size restrictions and forage area regulations, and will consider the implications of competing for limited forage in relation to private and commercial stock users. Use of both stock and aircraft will be kept to the minimum necessary commensurate with meeting project objectives and providing for firefighter safety.

Burned area emergency rehabilitation plans may be implemented under the direction of a resource advisor following significant fire management actions. Emergency rehabilitation in wilderness will seek to restore areas impacted by fire operations in ways that will restore and preserve wilderness character and conditions. Actions implemented under emergency conditions as part of immediate suppression and stabilization generally do not require pre-approval. Proposals for long term recovery actions will be submitted to the parks Environmental Management Committee, which will recommend and enforce the appropriate level of environmental compliance prior to implementation.

Fire related research and monitoring may occur to document and understand the effects of fire management actions in wilderness. Research and monitoring staff and equipment would create additional transient (short-term, infrequent) impact. Any proposal that required the installation of long term or permanent research or monitoring equipment in the wilderness will require a separate analysis and approval by the parks Environmental Management Committee.

WILD AND SCENIC RIVERS

The park contains two rivers, including the Kern and the South and Middle Forks of the Kings, which were designated as wild and scenic in 1987. Both rivers are contained within park wilderness, with the exception of the lower seven miles of the South Fork Kings which flows through the Cedar Grove developed area. Other rivers have been proposed for Wild and Scenic status through the General Management Plan.

The purpose of wild and scenic rivers as stated in legislation (Public Law 100-150) is that designated rivers "shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations."

All segments of the rivers in wilderness are in fire management zones that emphasize perpetuating fire as a natural process. As a result, the fire and fuels management program will not affect the rivers' free-flowing condition or involve new developments within their corridors.

Fire management tools #2 - #5 (described in Chapter 3) will be used in Wild and Scenic River corridors only to protect and enhance outstandingly remarkable values or to protect life safety, significant cultural and natural resource values, or to conform to air quality regulatory requirements.

All riparian areas, including wild and scenic rivers, will be protected from contamination by firefighting foams and aerial retardant following guidelines in the Fire and Aviation Management Operations Guide (FAMOG). Minimum Impact Techniques (MIT) detailed in the FAMOG are used throughout the parks and are especially critical to apply in Wild and Scenic River corridors.

Following fire, appropriate burned area rehabilitation measures may be taken to protect or restore outstanding resource values of designated Wild and Scenic Rivers. Rehabilitation following fire in a Wild and Scenic River corridor may be conducted under an approved *Burned Area Emergency Rehabilitation Plan*. Developing such plans during and after fire events is the joint responsibility of the park and incident management team.

6. Organization and Responsibilities

The parks' fire and fuels management organization is spread over three divisions. This arrangement creates an organization structure encouraging communication amongst park staff, benefiting both fire management and park operations affected by fire management actions. The majority of fire management staff is within the Division of Fire and Visitor Management. Fire staff is also in the Division of Resources Management and Science and the Division of Interpretation and Partnerships (Appendix G).

Communications for the fire and fuels program are also strengthened by the Fire Management Committee and district management teams. The purpose of the committee is to assist the superintendent and the fire management officer in the development, implementation, critique, and review of the fire management program. The FMC does not have decision authority but it makes recommendations on management to the superintendent. The Fire Management Committee (FMC) is chaired by the Chief of Natural Resources. The Committee includes:

- Chief of Resources Management and Science, Chair
- Chief of Visitor and Resource Protection, Deputy Chair
- Fire Management Officer
- Chief of Maintenance
- Science Advisor
- Research Scientist (BRD)
- Fire Ecologist
- Fire Education Specialist
- Fire Planner
- Safety Manager

In addition, there will be one district ranger and one district facility manager. At least one of these must come from the Sequoia Management Team and one from the Kings Canyon Management Team. District managers will generally serve a two-year rotating assignment with their counterparts in the other district.

The two district management teams are composed of district facility managers, district rangers, district FMOs, district interpreters, resource managers, and park concession/planning personnel. Each group works with the district FMOs to formulate the fire and fuels management program thereby minimizing impacts to other park operations or planning activities which could be affected by fire management.

ORGANIZATION ROLES AND RESPONSIBILITIES

Superintendent

- Has ultimate responsibility and accountability for all fire, aviation, and fuels management activities conducted within the park.
- Annually certifies Fire and Fuels Management Plan.

- Approves other plans written within the framework of the FMP (i.e. WFDSS and their periodic validations, burn plans, and mechanical fuels treatment plan).

Chief of Visitor and Resource Protection

- Serves a deputy chair of the Fire Management Committee.
- Supervises the parks Fire Management Officer and ensures communication occurs with Chief of Natural Resources, as well as the rest of parks' squad, on fire and fuels management issues.
- Ensures communication occurs within division on fire management issues (between park FMO, district rangers, and wilderness specialist).

Chief of Natural Resources

- Coordinates resource management review of plans for acceptance by superintendent.
- Ensures communication occurs with Chief of Fire and Visitor Management, as well as the rest of parks' squad, on fire and fuels management issues.
- Ensures communication occurs within division on fire management issues (between GIS specialist, biologists, and air quality specialist).
- Serves as the chair of the Fire Management Committee.
- Coordinates the parks' Resource Advisor Program (READ)

Fire Management Officer

- The Fire Management Officer (FMO) is responsible and accountable for providing leadership for fire and fire aviation management programs at the local level. The FMO determines program requirements to implement land use decisions through the Fire and Fuels Management Plan (FFMP) to meet land management objectives.
- Responsible and accountable for providing leadership for the fire and fire aviation management programs in the parks.
- Determines program requirements to implement land use decisions in the Fire Management Plan to meet land management objectives.
- Annually review the Fuels and Fire Management Plan to assure compliance with appropriate policy, standards, and guidelines.
- Ensures coordination with all divisions and FMC on fire planning and operations issues.
- Ensures coordination with external agencies for interagency cooperation in fire and fuels management planning and operations.
- Take necessary and prudent actions to ensure firefighter and public safety
- Develop, supervise, and implement a program of work based on the principles of a High Reliability Organization.
- Ensure sufficient qualified fire and non-fire personnel are available to support fire operations within the park at a level commensurate with the local and national fire situations.
- Ensure that all staff meets qualifications and standards necessary for the safe and efficient execution of their duties.

- Certify qualifications and issue Red Cards. Document and approve qualification overrides within the IQCS system when supported by compelling evidence.
- Evaluate operational needs to implement the Fire and Fuels Management Plan and request, secure, track, and efficiently expend those funds necessary to implement this plan commensurate with agency and park fiscal policy.
- Negotiate interagency agreements and represent the Park Superintendent on local interagency fire and fire aviation groups.
- Implement fire restrictions as identified in this plan.
- Submit the annual and five-year fuels treatment plans to FMC for review and to the Park Superintendent for approval.
- Oversee the implementation of all fire and fire aviation management activities within the park and assure that all actions are commensurate with standards, policy, and guidelines.
- Delegate specific responsibilities to subordinate supervisors and managers.
- Insure that a safe, efficient, and timely resonse is initiated to all wildland fire incidents.
- Provide provisional approval of Response to wildland fires until such time that the park superintendent is provided opportunity to approve or disapprove the planned actions.
- Regularly meet with cooperators to coordinate the safe and efficient use of interagency resources.
- Review fire weather, fire danger, and fire severity conditions and take necessary step-up actions to insure adequate wildland fire response.
- Manage employee fatigue by implementing and enforcing necessary work-rest guidelines to include granting administrative leave within the guidelines of the Interagency Incident Business Management Handbook when necessary to assure safe and effective wildland fire operations.
- Provide guidance, training, and decision making authority to subordinate supervisors to insure critical decisions are made in an appropriate and timely manner.
- Serve as the superintendent’s representative (Agency Representative) when hosting Incident Management Teams for actions implemented under this FFMP.
- Oversee prescribed fire operations to assure compliance with appropriate policy, standards, and guidelines. Review and recommend burn plans for approval of the superintendent.
- Approve Individual Wildland Fire Reports

Fire Budget Assistant

- Assures costs and expenditures within the Fire and Aviation Management Program are accurately tracked and the fire management officer and program managers are regularly briefed on the current budget status.
- Ensures payroll, personnel actions and travel documentation are completed for the branch.
- Coordinates with regional wildland fire budget representative and park budget officer on budget issues.
- Serves as subject matter expert for all fire business management issues.

Communications Center Manager (Supervisory Dispatcher)

- Ensures Wildland Fire Report database for wildland fire responses is current and correctly entered into all appropriate databases. Integrates this work with GIS specialist for GIS analysis.

- Manages wildland fire and all risk qualifications and training database for all park employees.
- Serve as the parks fire and aviation training officer. Represents the parks in interagency settings to facilitate training for fire management. Submits and tracks interagency training nominations.
- Catalogues all weather data for the parks' weather stations, manages fire danger rating analyses for parks.
- Submits and tracks the Incident Status Summary (ICS-209) information as directed by the Park Fire Management Officer or duty officer.

Cache Manager

- Develops, revises, and implements the fire and aviation dispatch and cache management processes.
- Coordinates logistical support for all fire/aviation planning and operations.

Fuels Management Specialist

- Principal program manager and staff specialist for all fuels management activities within the park.
- Delegated authority by the Fire Management Officer to budget and expend designated funds for fuels management activities commensurate with policy, standards, and guidelines.
- Assures that all fuels management operations are conducted in a safe and efficient manner commensurate with the standards associated with a High Reliability Organization.
- Ensures appropriate fire monitoring is implemented for all fire incidents.
- Responsible for developing and implementing the fuels management programs in direct coordination with district FMOs and with consultation from the Fire Ecologist, Fire GIS Specialist, and Fire Information and Education Specialist. Has decision authority on park priorities for treatments subject to approval by the Fire Management Officer. Formulates annual fuels treatment plan working from the 5-year plan.
- Takes lead on yearly fire GIS analysis planning update.
- Coordinates projects with fuels planners from cooperating agencies.
- Serves as the primary point of contact with San Joaquin Valley Air Pollution Control District and coordinates all fuels management activities with the SJAPCD. Ensures District FMOs and burn bosses comply with park smoke management protocols for all wildland fire and prescribed fire operations.
- Principal staff specialist for wildland fire behavior prediction and analysis, and for climatological data analysis.

Sequoia District FMO

- Program manager responsible for district's wildland fire management program.
- Evaluates the needs for fuel treatment in coordination with the Park Fuels Specialist. Proposes fuels projects and advises the Park Fuels Specialist of issues or problems that could develop as part of any project proposal.
- Represents Fire Management on the Sequoia District Management Team. Presents the annual program of work to the management team. Coordinates the resolution of interdivisional issues within district that are the result of fire management activities and programs.

- Coordinates use of district resources in support of park-wide project/wildland fire priorities.
- Delegated authority by the Fire Management Officer to budget and expend designated funds for district fire management activities commensurate with policy, standards and guidelines.
- Assures that all fire management activities within the district are planned and conducted in a safe and efficient manner commensurate with the standards associated with a High Reliability Organization.
- Delegated the authority of park Aviation Officer and directed to manage the park aviation program for both Sequoia and Kings Canyon National Parks per the parks' Aviation Management Plan and interagency aviation standards and guidelines.
- Coordinates fire management activities with permittees and private inholders in the district.

Kings Canyon District FMO

- Program manager responsible for district's wildland fire management program.
- Evaluates the needs for fuel treatment in coordination with the Park Fuels Specialist. Proposes fuels projects and advises the Park Fuels Specialist of issues or problems that could develop as part of any project proposal.
- Represents Fire Management on the Kings District Management Team. Presents the annual program of work to the management team. Coordinates the resolution of interdivisional issues within district that are the result of fire management activities and programs.
- Coordinates use of district resources in support of park-wide project/wildland fire priorities.
- Delegated authority by the Fire Management Officer to budget and expend designated funds for district fire management activities commensurate with policy, standards and guidelines.
- Assures that all fire management activities within the district are planned and conducted in a safe and efficient manner commensurate with the standards associated with a High Reliability Organization.
- Delegated the authority of Structural Fire Coordinator per RM-58, Structural Fire for both Sequoia and Kings Canyon National Parks. Serves as Chair of the Structural Fire Working Group. Principal coordinator for structural compliance and planning issues within the parks. Programs, tracks, and expends structural fire funds.
- Coordinates fire management activities with permittees and private inholders in the district.

Duty Officer

Duties identified in the 2013 RedBook Section 03-13:

- Monitor unit incident activities for compliance with NPS safety policies.
- Coordinate and set priorities for unit suppression actions and resource allocation.
- Keep Agency Administrators, suppression resources and Information Officers informed of the current and expected situation.
- Plan for and implement actions required for future needs.
- Document all decisions and actions.

Delegated Authorities:

- Determine the appropriate response to a wildland fire commensurate with the Park's Wildland Fire Management Plan.
- Order appropriate resources needed for incident management commensurate with valves at risk.
- Determine strategic incident objectives, assign, and brief a qualified Incident Commander.
- Review and approve daily staffing level. Recommend staffing level modifications to the District FMO or Park FMO.
- Authorize and expend overtime.

Responsibilities:

- Oversee all incident operations on wildland fires and insure that all actions are undertaken in a safe, tactically sound, and fiscally responsible manner.
- Notify the appropriate District Fire Management Officer, the Park Fire Management Officer or their acting, and the on-call Resource Advisor of a fire occurring as soon as possible and provide situation updates as necessary.

Fire Ecologist

- Principal program manager and staff advisor to the parks fire management program on ecological issues, assuring that the best ecological practices and principles are consistently considered in all fire management decision making.
- Delegated authority by the Fire Management Officer to budget and expend designated funds for fire ecology activities commensurate with policy, standards and guidelines.
- Develops and implements fire effects monitoring program based upon structural and process objectives for the vegetation communities.
- Ensures that results from fire effects monitoring and fire research are integrated into the fire and fuels management program.
- Analyzes and reports results from monitoring data so that fire management operations can be adjusted to better meet structural and process objectives.
- Reviews both annual and five-year fuels treatment programs to assure that ecological needs are adequately addressed as an integral part of the planning process.
- Primary resource advisor (READ) for all wildland fire management activities within the parks and assures that resource concerns are identified and mitigated as required part of the planning process.
- Coordinates fire research needs.
- Summarizes the significant findings of all park fire research in an annual report that is circulated internally and externally.
- Provides supervision and direction to the parks fire effects crew and supervisor.

Air Quality Management Specialist

- Principal staff advisor to the parks fire management program on air quality issues, assuring that air quality issues are adequately addressed as part of the fire management decision making process.

- Coordinates air quality data and information exchange with Fuels Management Specialist as well as coordination with interagency partners.
- Provides quality assurance/quality control and provides direct supervision for the smoke and weather technician.

Fire GIS Specialist

- Primary program manager and analyst for fire related geographic databases within the parks. Assess and assure quality control of fire related geographic databases. Maintains fire databases.
- Sets standards for data collection and storage. Coordinates electronic file management for fire management. Manages electronic data security for fire management.
- Delegated authority by the Fire Management Officer to budget and expend designated funds for fire GIS activities commensurate with policy, standards and guidelines.
- Provides project level spatial analysis and mapping for all fires.
- Provides spatial analysis and map products for fire and fuels management planning.

Fire Information and Education Specialist

- Principal program manager and staff advisor for Fire Information and Education, assuring accurate and cohesive information is provided to the staff and the public in a timely manner.
- Coordinates and facilitates information exchange between program managers and the Fire Management Officer.
- Primary representative for the fire management program to the media and the public.
- Delegated authority by the Fire Management Officer to budget and expend designated funds for fire information and education activities commensurate with policy, standards and guidelines.
- Communicates with internal and external audiences about fire and fuels management program activities. Primary author and/or editor for all public news releases for fire management.
- Coordinates, assembles, and distributes annual updates to the Fire Management Plan.
- Facilitates year-round educational opportunities about fire ecology, history, and management.

Fire Planner

- This is an interagency position with the Sequoia National Forest.
- Supports wildland fire operationally by ensuring that WFDSS planning documents are developed and periodically updated for all fires requiring a WFDSS document.
- Provides backup to the Fire Information and Education Specialist in preparing news releases and providing interpretation to the public when needed.
- Responsible for annual updates to the Fire and Fuels Management Plan and spearheads the process to develop new FFMP's when needed.
- Provide support to fire managers in the southern Sierra Nevada including Sequoia National Forest and Bakersfield Field Office of the BLM. This includes providing WFDSS fire behavior analysis operationally and other planning projects as needed.
- Project lead for the Sierra Wildland Fire Reporting System (SWFRS) website sponsored by the interagency Southern Sierra Fire Management Officers (SSFMO) group.

- Collateral duties include a variety of assigned tasks as they arise.

FIRE MANAGEMENT FUNDING

The fire and fuels management program funding comes from two sources; Fire Management Program Center (FMPC) and National Park Service ONPS funds. As of 2013, annual program funding from both sources totals approximately $2,700,000 exclusive of fuels treatment project funds, emergency funds for wildland actions, and construction or other special project actions. ONPS funds account for about $350,000 of this figure covering aviation personnel, a program assistant, a fire planner, a district FMO, and the parks' FMO. These funding levels represent a significant reduction below historic funding levels.

INTERAGENCY COORDINATION AND CONTACTS

The following table (Table 6-1) lists the national, regional, and local agreements that pertain to the implementation of this *Fire and Fuels Management Plan*. Copies of each agreement are filed in the "Fire Agreements" binder in the Fire Management Office

Table 6-1: Memorandums of Understanding (MOU), Memorandums of Agreement (MOA), and Operating Plans Related to Fire and Fuels Management Program

Title of Agreement	Cooperators	Key Contacts	Purpose of Agreement
State and Regional			
Master Joint Operations Agreement: Four-Party	Bureau of Land Management, California and Nevada National Park Service, Pacific West Region US Forest Service, Regions 4-6 California Department of Forestry and Fire Protection	N/a	Coordinates state-wide wildland fire protection
Cooperative Agreement for Local Government Fire Suppression Assistance to Forest Agencies: Five-Party Agreement	State of California, Office of Emergency Services California Department of Forestry and Fire Protection US Forest Service, Regions 5 Bureau of Land Management, California National Park Service, Pacific West Region	N/a	Allows for local government involvement in state and federal wildland fire actions
Cooperative Agreement Among State of California Military Department	State of California Military Department California Department of Forestry and Fire Protection Bureau of Land Management, California US Forest Service, Regions 5 National Park Service, Pacific West Region State of California, Office of Emergency Services	N/a	Allows for state activation of military including modular airborne firefighting systems (MAFFS)
National Park Service and California Department of Forestry and Fire Protection Conservation Camp Agreement	California Department of Forestry and Fire Protection National Park Service, Pacific West Region	N/a	Directs how to utilize conservation camp crews on fire and fuels operations
Operating Plan for Incident Billing Procedures	Bureau of Land Management, California National Park Service, Pacific West Region Bureau of Indian Affairs, Sacramento Area US Forest Service, Pacific Northwest Region US Forest Service, Regions 5 California Department of Forestry and Fire Protection	N/a	Ensures state and federal agencies full and equitable cost recovery for wildland fire operations
Local			
Central Sierra Operating Plan	Bureau of Land Management, Central California Region National Park Service: Sequoia and Kings Canyon, Yosemite US Forest Service: Eldorado, Giant Sequoia National Monument, Sequoia, Sierra, and Stanislaus California Department of Forestry and Fire Protection: Amador-El Dorado, Tuolumne-Calaveras, Madera-Mariposa-Merced, Fresno-Kings, and Tulare	Chris Schow Chief, Fire and Aviation Management Stanislaus National Forest	Operating Plan tiered from the Four-Party Agreement listed above

Title of Agreement	Cooperators	Key Contacts	Purpose of Agreement
Operating Plan for the South Central Sierra Interagency Incident Management Teams	US Forest Service: Sierra, Sequoia, Giant Sequoia National Monument, and Stanislaus National Park Service: Sequoia and Kings Canyon, Yosemite Kern County Fire Bureau of Land Management: Central California Region	Vacant Center Manager Sierra National Forest Emergency Coordination Center	Outlines plan for mobilizing Type II Province Team
Sequoia National Forest Emergency Communications Center Interagency Expanded Dispatch Plan	US Forest Service: Sequoia and Giant Sequoia National Monument Bureau of Indian Affairs: Tulare Reservation National Park Service: Sequoia and Kings Canyon National Parks Bureau of Land Management: Central California Region	Steve Phillips Center Manager Central California Interagency Coordination Center	Outlines plan for setting up expanded dispatch for large incidents
Memorandum of Understanding Between Sequoia and Kings Canyon National Parks, Reedley College, and Sequoia Lake YMCA Camp	National Park Service: Sequoia and Kings Canyon National Parks Reedley College Sequoia Lake YMCA Camp	David Allen Fire Management Officer Sequoia and Kings Canyon National Parks Wayne Bemis Reedley College Sequoia Lake YMCA Camp Manager	Allows educational exchange between parks and the college through college forestry camp activities on federal lands in the vicinity of Sequoia Lake
Memorandum of Understanding between Sequoia and Kings Canyon National Parks and Three Rivers / Lemon Cove Business Association	National Park Service: Sequoia and Kings Canyon National Parks Three Rivers/Lemon Cove Business Association	Fire Information and Education Specialist Sequoia and Kings Canyon National Parks Tom Marshall Three Rivers / Lemon Cove Business Association	Allows for cooperative maintenance of joint bulletin board in Three Rivers
Unified Guidelines and Procedures (updated annually) San Joaquin Valley Unified Air Pollution Control District and Land Management and Fire Protection Agencies Note: This document is used instead of a formal agreement.	San Joaquin Valley Unified Air Pollution Control District US Forest Service: Sequoia National Forest, Giant Sequoia National Monument, and Sierra National Park Service: Sequoia and Kings Canyon National Parks and Yosemite National Park Lemoore Naval Air Station Southern California Edison Bureau of Land Management: California US Fish and Wildlife Service: San Luis National Wildlife Refuge Complexes California Department of Forestry and Fire Protection	Daniel Martinez San Joaquin Valley Unified Air Pollution Control District	Allows for smoke planning and management in local Air District
Interagency Agreement between Inyo National Forest and Sequoia and Kings Canyon National Parks	US Forest Service: Inyo National Park Service: Sequoia and Kings Canyon National Parks	Park Fuels Management Specialist Sequoia and Kings Canyon National Parks	Allows for smoke management monitoring of park fires from Inyo National Forest land

Title of Agreement	Cooperators	Key Contacts	Purpose of Agreement
Memorandum of Understanding between Tulare County and Sequoia and Kings Canyon National Parks	Tulare County National Park Service: Sequoia and Kings Canyon National Parks	David Allen Fire Management Officer Sequoia and Kings Canyon National Parks Joe Garica Chief, Tulare County Fire Department	Allows for exchange of resources for structural fire and wildland urban interface fires
Southern Sierra Fire Management Officer Group (Charter in draft)	National Park Service: Sequoia and Kings Canyon, Yosemite Bureau of Land Management: Central California Region US Forest Service: Stanislaus, Sierra, Sequoia, Giant Sequoia National Monument, Humboldt-Toiyabe, and Inyo	Fire Management Officers for all units	Allows for coordination among federal southern Sierra land management agencies on fire, non-fire, and air quality issues

7. Firefighter and Public Safety

FIREFIGHTER SAFETY

Wildland fire operations are high risk operations that require all personnel to be mindful in all aspects of their work, including planning and implementation. Our fire program implements safety processes developed within the interagency wildland fire community and based on the work by Dr. Karl E. Weick. The fire program at Sequoia and Kings Canyon strives to be a Highly Reliably Organization. In short our fire program will identify and mitigate risk as part of every action that we take.

The fire staff pursues an iterative process of continual improvement always focused on learning from our past to improve our future. Our goal is an organizational cultural that: 1) Encourages and rewards reporting errors 2) Finds solutions to small emerging failures before larger problems surface and 3) Implements and uses the best practices that result in a safer working environment.

The high risk nature of wildland fire work does not allow any margin for error. If any fire or fuels management action cannot be carried out safely, another action must be utilized. Prevention of injury is the overriding consideration during all operations. It is the responsibility of each and every person involved in an operation to ensure safety. At no time will the protection of resources be placed before the safety of fire management personnel. The Fire Management Office at Sequoia and Kings Canyon National Park outlines safety policy in more detail in the *Fire and Aviation Management Operations Guide* (Addendum).

Using GIS analysis, the parks have identified areas that present high hazard to firefighters (e.g. steep, remote areas having dangerous fuel conditions). In these areas, where firefighter safety mitigations are difficult or impossible to achieve, the park may opt for less aggressive control strategies and accept fire spread over a greater number of acres.

Fire Safety Committee

The purpose of this committee is to assist the Fire and Aviation Management Program in the development, implementation, critique, and review of the Fire and Aviation Operations Program. The committee is the focal point of fire management's safety program. The committee does not manage fire operations; it advises on fire and aviation operations.

The committee is comprised of a permanent employee from each of the following modules or programs: Engine 72, Engine 51, Helicopter 552, Arrowhead Hotshots, Fuels Management, Crew 91, Crew 9and a program manager to serve as the management representative.

The function of the committee is to:

- Serves as the focal point for the Fire Management Organization's goal of being a Learning Organization.

- Monitors fire management operations to detect “weak signals” of failure early in their history.
- The committee will encourage After Action Reviews (AARs) to be conducted at the end of each operation period during incident operations.
- Significant events identified during AARs will be documented by the responsible Incident Commander or Module Leader and forwarded to the Chair of the Fire and Aviation Safety Committee for review.
- Significant events or near misses will be documented in an After Action Review Rollup (AAR Rollup).
- All AAR Rollups will be reviewed at the End of Season Operations Meeting in November.
- Recommended new Best Practices from the AAR Rollups that will improve the fire and aviation management operations.
- Facilitates accident reviews and Safenet/Safecom responses. Fire Management Officer will inform the committee of submitted Safenets/Safecoms and accidents.
- One committee member will serve on the refresher cadre for the purpose of disseminating Lessons Learned and providing orientation to the JHA process.
- Memebership on the committee is a collateral function.

This committee shall advocate that all operations be carried out in accordance with established safety practices as set by *Reference Manuals 18, 58,* and *60,* the Fireline Handbook (NWCG 410-1), OSHA, the parks’ *Risk Management Plan*, policy, and the division safety plan (Addendum).

The committee is not meant to replace the role of fire program managers and first line supervisors, but rather to expand the availability of safety information for firefighters. Program managers and first line supervisors are responsible for the establishment of Job Hazard Analyses (JHAs) which are written descriptions of hazards and corresponding mitigations for fire operations. Program managers will regularly review, modify, and update JHAs. Furthermore, the established JHAs will be readily accessible for crews so they may be able to integrate them into daily operations and projects. Currently, these JHAs are available on the park computer network under *J:./share_docs/fire/safety*.

Wildland Fire Program

Due to many decades of fire suppression, unnatural fuel loads have accumulated in certain areas of the parks creating the potential for dangerous fires. Firefighters will only be allowed on an active wildland fire after receiving proper equipment and training as specified in Reference Manual-18. This includes an annual eight-hour wildland firefighter safety class. The fire management office will coordinate this class and make it available to every firefighter each season. Lead instructors of this class will be qualified at the strike team level. Employees failing to attend will not be allowed on the fireline until class completion.

Furthermore, wildland firefighters must meet minimum physical standards for their assigned incident position, as defined in NWCG 310-1 “Wildland Qualifications Subsystem Guide.” Physical fitness/work capacity tests for wildland firefighters and other fire-qualified employees will consist of the “pack test.” Arduous duty medical exams must be taken once every 3 years by wildland firefighters. The exams only include stress EKGs if required by the examining physician or if the employee is over 41 years old.

Aviation Program

The Park Aviation Manager (Sequoia District FMO) will manage the parks' aviation program. The two primary hazards for aviation work in the parks are mountainous terrain and the high risk nature of wildland fire and SAR operations. Park staff will primarily mitigate the hazards and reduce the overall risk of aviation missions by: 1) Limiting flights necessary for core park operations 2) Using only qualified personnel to manage aviation operations 3) Following established policies found in the Federal Aviation Administration rules and regulations, the Department of Interior Departmental Manual, and NPS Aviation Management Policy as outlined in Reference Manual #60. Furthermore, the Park Aviation Manager (Sequoia DFMO) will be responsible for establishing and updating the parks' *Aviation Management Plan*.

Structure Fire Program

The Structure Fire Coordinator (Kings Canyon DFMO) will manage safety in the structure fire program. Emphasis will be placed on proper training and physical requirements as outlined in National Park Service Director's Order #58. The parks will be careful to distinguish between the requirements for structure and wildland fire. The two types of work are not interchangeable. Wildland firefighters will not be used in structure protection without proper structural fire training, appropriate medical examination, and fitness testing.

PUBLIC AND EMPLOYEE SAFETY

During fire operations or extreme fire danger, fire use restrictions and emergency closures may be needed to ensure public safety (see Appendix M). These restrictions can also reduce the possibility of human-caused fires during seasonal drought or extreme fire conditions. Emergency closures (i.e. trails in a fire area) may be declared by an incident commander to prevent imminent danger. Consultation with the appropriate District Ranger will occur as soon as possible. For longer term restrictions or closures (i.e. Stage 1, Stage 2 or Stage 3 fire restrictions), a special order will be approved by the park superintendent and given wide distribution. For all restrictions and closures signs will be posted and maintained in appropriate areas.

Evacuation plans will be in place and ready in the event of an unforeseen dangerous wildfire. When a fire threatens visitor or employee safety, adjacent ranger districts need to be given as much advance notice as possible in order to achieve orderly evacuation. Park evacuation plans are kept at the district ranger offices and are activated when an emergency dictates the need. The evacuation procedures of park residents are also outlined in these district plans.

During certain fire operations (such as prescribed fires or fire use projects), the parks may decide to keep trails open and allow visitors access to the fire area. If this happens, firefighters and interpreters on scene will answer questions and give safety messages to the public.

Firefighters or other park staff may also serve as escorts through fire areas. The parks will supply media representatives with personal protective equipment (PPE) when needed.

8. Description of the Parks

LOCATION AND GEOGRAPHY

Sequoia and Kings Canyon National Parks are located in the eastern part of central California. Park headquarters at Ash Mountain (in Sequoia National Park) are located 175 air miles north of Los Angeles and 215 air miles southeast of San Francisco. Both parks occupy the western slope of the Sierra Nevada, the 400-mile-long mountain range that forms the eastern edge of the California biological and cultural province. Combined acreage for the two parks is over 865,960 acres.

Kings Canyon is the northern of the two parks and consists of two sections. The small, detached General Grant Grove section of Kings Canyon National Park preserves several groves of giant sequoia including the General Grant Grove, with the famous General Grant Tree, and the Redwood Canyon/Redwood Mountain Grove, which is the largest remaining natural giant sequoia grove in the world. This section of the park is mostly mixed conifer forest, and is readily accessible via paved highways.

The remainder of Kings Canyon National Park, which comprises over 90% of the total acreage of the park, is located to the east of General Grant Grove and forms the headwaters of the South and Middle Forks of the Kings River and the South Fork of the San Joaquin River. Both the South and Middle Forks of the Kings Rivers have extensive and spectacular glacial canyons. One portion of the South Fork canyon, known as the Kings Canyon, gives the entire park its name. The Kings Canyon, and its developed area, Cedar Grove, is the only portion of the main part of the park that is accessible by motor vehicle. Both the Kings Canyon, and its Middle Fork twin, Tehipite Valley, are glacial "Yosemites" – deeply incised glacial gorges with relatively flat floors and towering granite cliffs thousands of feet high. To the east of the canyons are the high peaks of the Sierra Crest culminating in 14,242-foot-high North Palisade, the highest point in the park. This is classic High Sierra country – barren alpine ridges and glacially scoured lake-filled basins.

Usually snow free only from late June until late October, the high country is accessible only via foot and horse trails. The Sierran crest forms the eastern boundary of the park. Altogether, Kings Canyon National Park contains 722 square miles.

Sequoia National Park lies south of Kings Canyon and adjoins it. The park consists of a single unit that rises from the low western foothills to the crest of the Sierra at 14,495-foot-high Mt. Whitney, the highest point in the 48 contiguous states. The western third of the park consists of two natural regions – a zone of foothill vegetation below 5,000 feet, and an extensive band of mixed conifer forest between 5,000 and 9,000 feet. This latter forest contains 32 separate giant sequoia groves, including the famous Giant Forest, which covers three square miles and contains the world's largest tree – General Sherman. Both the Generals Highway and the Mineral King Road provide vehicular access to this western third of the park. Immediately east of the forest belt is the Great Western Divide, a north-south ridge that runs through the middle of Sequoia National Park. Peaks in the vicinity of the Divide rise as high as 13,802 feet.

The eastern half of the park consists of the alpine headwaters of the North Fork of the Kern River, the glacial trench of Kern Canyon and the Sierra Crest itself, which runs north-south and forms the eastern boundary of the park. All of this area, which comprises approximately two-thirds of Sequoia National Park, is designated wilderness. Like the eastern highlands of Kings Canyon National Park, the eastern portion of Sequoia is a high, cold land of stark beauty. Sequoia National Park contains 632.7 square miles.

The parks contain resources of geological, biological, cultural, and sociological value. In addition to holding national park status, the two reservations have also been designated as a unit of the International Biosphere Preserve Program and 85% of the parks have been designated wilderness.

GEOLOGY AND TOPOGRAPHY

The Sierra Nevada is generally considered to have been formed by the detachment and uplifting of a large portion of the earth's crust resulting in a massive block, or batholith, tilted to the west in a long, moderate slope which is segmented laterally by deep canyons.

In the area of Sequoia and Kings Canyon, the western edge of this fault lies several thousand feet below the level of the San Joaquin Valley, buried beneath the gravel, sand, and mud which has washed down the range. The eastern profile is characterized by a precipitous escarpment plunging from the upper reaches of the block to the Owens Valley below. The rugged topography ranges from 1,500 feet at the southwestern boundary to 14,495 feet at the summit of Mt. Whitney on the eastern crest.

The land surface of the parks has been deeply eroded by stream and glacial action. The South Fork of the San Joaquin River and the Middle and South Forks of the Kings River constitute the major hydrological drainages of Kings Canyon National Park. The canyons of the two forks of the Kings River are two of the deepest in the United States.

All five tributaries of the Kaweah River; North, South, East, Middle and Marble Forks - originate in and drain the western portion of Sequoia National Park. The Kern River drains the eastern portion of the park. Originating along the Great Western and Kings-Kern Divides, the Kern flows south rather than following the westerly flow of other major rivers of the Sierra Nevada.

About 2000 alpine lakes are found throughout the higher portions of the two parks. Most are not deep, as they occupy the shallow rock basins formed by glacial action. Numerous streams drain from high elevation lakes and springs into the larger river canyons.

The fundamental basis of the great tilted block which created the Sierra Nevada is igneous rock; granite in various forms and textures. Massive domes such as Moro Rock and Tehipite Dome are common, as well as perpendicular cliffs, exfoliated slabs, broken talus, rectangular blocks, and huge boulders. Metamorphic rocks such as marble, schist, and quartzite are found throughout most of the parks. J.G. Moore has constructed geologic maps of several quadrangles, as well as discussed other geologic aspects of these parks (Moore and Dodge 1980).

Glacial action has extensively shaped the terrain of the parks. Several large canyons, all exhibiting the typical U-shaped valley, trend westward from the Sierra crest. A few glaciers dot the higher elevations and have created the numerous lake basins characteristic of this region. Moraines outline the courses of the ancient glaciers and mark the extent of ice flows in the canyons.

The two parks contain over 270 known karst features. Several major cave systems have been located, including Lilburn Cave, which is the most extensive in California with over 21 miles of measured passages. The two parks contain some of the wildest and least-impacted caves in the United States.

SOILS

The soils of the parks are primarily granitic in origin. Depths vary from several feet in limited low elevation areas on the western slope, to a very thin or nonexistent soil mantle at higher elevations which resulted from glacial scouring in the alpine and subalpine areas. While no definitive soils map has been made for the parks, Storie (1953) has classified the soils of this general area as upland residuals, which have formed in place by the disintegration and decomposition of the underlying parent rock. Huntington and Akeson (1987) have mapped soils in the Kawaeh drainage.

This upland category is further divided into two groups, which are applicable to these parks. Rolling, hilly-to-steep upland having acid residual soils of good depth to bedrock is common to much of the timbered portion of the parks. These podzolic soils are characterized by depths of three to six feet to bedrock and a moderate to strongly acid reaction. Residual soils of very shallow depth to bedrock are found throughout most of the remainder of the parks, especially at the higher elevations.

CLIMATE

One of the unique characteristics of the Sierra Nevada is its climate. This area enjoys a relatively mild, Mediterranean climate with a distinct winter-spring wet season and an equally distinct summer-fall dry season. Lower elevations are generally warm and clear in winter and hot and dry during the summer, whereas higher elevations are cool during the summer, and cold in the winter.

The average annual temperature at Ash Mountain Headquarters (elevation 1,700 feet) is 63 °F, with extremes of 114 °F and 17 °F having been recorded. Extremes of 91 °F and 1 °F have been recorded at Giant Forest (elevation 6,409 feet) where cool daytime and evening temperatures prevail during the summer and cold nights and moderate to relatively mild days are common during the winter.

The average annual precipitation in the lower elevation foothills at Ash Mountain is 27 inches. Lodgepole receives an average annual precipitation of around 47 inches, Grant Grove around 42 inches.

Most winter precipitation above 5,000 feet occurs in the form of snow. Mean snow depths at 6,400 feet average 40 inches with 17 inches of water content. Snow infrequently falls at the lower elevations in small amounts; it usually melts within a few days.

The general wind is from the west to southwest. Strong winds are rare at lower and middle altitudes but more common at higher elevations and ridgetops. Thunderhead downdrafts can be both erratic and intense. Canyon winds generally follow the daily pattern of blowing up-canyon during the day and down-canyon during the night.

Cook et al. (2004, 2007) note, based on reconstructions of precipitation and drought patterns using tree rings, long-term megadroughts, some multi-decade in length, have occurred during the last 1,100 years in California. They also note that "the period since 1890 has been one of greater wetness," relative to the last 1,100 years as a whole. Additionally, a multi-century period of significantly elevated aridity, compared to the last 100 years, was also found to have occurred from around AD 900 to 1300. Westerling et al. (2006) found increasing warming and earlier springs during recent decades.

The recent trend in increasing temperatures is consistent with Global Climate Change predictions. The average summer temperatures are predicted to increase an additional 4-8^{o} and winter temperatures to increase 2-4^{o} over the next century. While predictions for precipitation are highly uncertain, most predictions agree that summers will be drier. Regardless of changes in precipitation, warming temperatures will increase the fraction of rain relative to snow, speed the onset of snowmelt and increase the amount of water used by plants and evaporated by the atmosphere.

VEGETATION

Extreme topographic differences and a striking elevation gradient (ranging from 1,360 feet (412 m) in the foothills to 14,494 feet (4,417 m) along the Sierran crest) create a rich tapestry of environments, from the hot, dry lowlands along the western boundary to the stark and snow-covered alpine high country.

This extreme topographic diversity in turn supports over 1,200 species (and more than 1,560 taxa, including subspecies and varieties) of vascular plants, which make up over 150 unique plant associations. A detailed map of the vegetation in the two parks was finalized in 2007 as part of the NPS Inventory & Monitoring program, in close collaboration with both local and regional fire programs. For descriptive purposes these communities are categorized primarily on the basis of dominant vegetation and their elevation limits.

The parks contain biological resources of the highest level of significance. Congress created Sequoia and General Grant National Parks in 1890 expressly to protect the giant sequoia. The General Sherman Tree, growing in Sequoia National Park's Giant Forest, is generally recognized as the largest sequoia and the largest living tree on earth. Three other trees in the Giant Forest, and the General Grant Tree in Kings Canyon National Park, complete the list of the five largest single organisms (excluding giant fungus and aspen clones) in the world.

Sequoia trees do not grow continuously through the mixed conifer forest belt, but rather in geographically limited areas called groves. In the Sierra Nevada, the only present natural home of the sequoias, the trees grow in roughly 75 separate groves. The 39 named groves in the two parks contain roughly one-third of all naturally occurring sequoias.

The biological resources of the two parks are not limited to giant sequoias. Extensive tracts of Sierran mixed conifer forest surround the sequoia groves. This forest belt, which generally clothes the mountains at altitudes between 5,000 and 9,000 feet, covers much of the southern Sierra. On surrounding lands, however, the great majority of this forest zone is being managed for multiple uses. As a result, the parks now contain the largest remaining old growth forest in the southern Sierra. This forest is a very significant resource because its largely pristine nature gives it both a high recreational value and a very critical scientific value.

Below the conifer forest, in the western portions of the Sierra, are the various plant communities and environments that together constitute the foothill region. Kings Canyon contains very little land within this natural zone; but in Sequoia National Park, the lower canyons of the several forks of the Kaweah River include extensive foothill lands. This environment, typified by blue oak savanna, chaparral, and oak woodland, covers much of lowland Central California outside the parks. However, very little of this non-park land is receiving any protection. In the southern Sierra Nevada, the foothill lands of Sequoia National Park are among the only foothill tracts currently designated for long-term preservation.

The remainder of the parks, most of it above 9,000 feet in altitude, can be described as High Sierra. This environment, which covers nearly as much acreage as the other two parks' environments combined, is a spectacular land of rugged, ice-sculptured alpine ridges and sparsely wooded lake-jeweled basins. As the heart of the largest wilderness area in California, these lands are of very high recreational and scientific significance.

Non-native plants have the potential to displace native plants and alter the structure and processes of native plant communities. Research biologists at the parks have recently completed baseline surveys identifying over 210 non-native species within its boundaries. With several highly invasive species currently forming discrete populations within the parks and several poised along the parks' boundaries, a comprehensive management program focused on prevention, early detection and eradication will prevent many species from becoming widespread, ecologically damaging, and expensive problems.

WILDLIFE

The preservation of native wildlife within the two parks results naturally from the habitat protection that the parks afford and adds yet another level of biological significance. While the wildlife found within the parks does not differ significantly from that found naturally on surrounding lands, those lands are mostly undergoing profound changes in development. As a result, the wildlife protection function of the parks is becoming increasingly important. The regional survival of a number of species may ultimately be largely dependent upon the protection the parks provide.

The various plant communities of the parks support a rich diversity of wildlife species as both year round residents and migratory visitors. Of the vertebrates, the parks are known to have 263 native terrestrial species, and nine more species may be present. Of the native vertebrates, six species are extirpated, and 143 are rare or uncommon. The 331 vertebrates include 12 species of amphibians, 24 species of reptiles, 204 species of birds, and 83 species of mammals. Rather than confining themselves to a single ecosystem, most species range between several of the habitats described. Far-ranging species such as the mule deer, black bear, mountain lion, red-tailed hawk, golden eagle, coyote, , and fisher occur within its boundaries. Several Sierra Nevada bighorn sheep herds, which spend the summer in portions of the alpine and subalpine ecosystems of these parks, are estimated to have approximately 300 individuals and increasing as of 2012 (only about 500 exist in total).

In addition to native wildlife species found in the parks, people have introduced a few exotic species. The Rio Grande turkey, starling, Virginia opossum, and House sparrow are occasionally seen at lower elevations.Feral pigs and cattle are also present in the foothill and mid-elevations of the parks. The chukar partridge has been observed in the alpine ecosystem. However, the abundance of these exotics is quite low.

AQUATIC RESOURCES

These parks contain a rich array of diverse wetlands and deepwater habitats. The entire area has been surveyed and mapped by the U.S. Fish and Wildlife Service as part of the National Wetlands Inventory. Additionally, the parks completed a more detailed and more accurate vegetation maps of the parks in 2007. The primary types of wetlands and deep-water habitats are persistent palustrine emergent (wet meadows), deciduous broad-leaved palustrine scrub-shrub (primarily willow thickets), upper perennial riverine (permanent rivers and streams), lacustrine (lakes), open-water palustrine (ponds), and intermittent riverine (ephemeral streams). Many of the rivers and streams have riparian areas that are either forested palustrine (e.g., alder) or deciduous broad-leaved palustrine scrub-shrub (e.g., spice bush) along their banks.

Wetlands are some of the most important areas ecologically and also among the most fragile. In the Sierra Nevada Ecosystem Project, aquatic resources were identified as among the most impacted in the Sierra Nevada (SNEP 1996). On the other hand, wetlands are one of the great cleansers of human nutrients. As such, they help mitigate some nutrient impacts and it is probably because of the responsiveness of wetlands to absorb nutrients that human nutrient enrichment was not found conclusively at high-use backcountry sites.

Water is a powerful attractant for people, and the interface between water and the terrestrial world is often a wetland. Wetlands and deep-water habitats are the stage for many park resource issues. Issues relate to degradation of biological communities and structural landscapes in wetlands and deep-water habitats. Specific wetland issues include: 1) impacts to wetland flora and fauna as a consequence of grazing by pack stock, 2) impacts to riparian areas due to illegal trespass grazing, 3) destruction of wetland flora due to social trails forming around lakes, 4) exotic wetland flora, 5) degradation of stream banks in high-use areas, 6) disturbance of lake and stream bottoms by swimmers, waders, and anglers, 7) the need for floodplain studies in all developed areas of these parks, and 8) loss of natural fire as a force that influences the composition and structure of some wetlands.

For purposes of distinguishing aquatic fauna from terrestrial fauna, aquatic wildlife is defined as species that depend on occupying either lentic or lotic environments for all or portions of their life. These species may be either fully aquatic or amphibious. Aquatic wildlife does not include species that frequent wetlands or deep-water habitats but which are not obligate occupants of (or dependent on) those environments (e.g., long-tailed vole, *Microtus longicaudus*).

Of the vertebrates, the parks are known to have 47 native species that fit this definition, and seven more species may be present. Of the 47 native vertebrates, one species (*Rana boylii*) is extirpated, and 34 are rare or uncommon. The 46 vertebrates include five fish taxa, seven species of amphibians, three species of reptiles, 30 species of birds, and two species of mammals. One species is federally listed as threatened. Three are federal candidate species. One is state-listed as endangered and one is state-listed as threatened. Twelve are sensitive species, of which listings include federal sensitive, California sensitive, California protected, and Forest Service sensitive.

While there have been some studies of aquatic invertebrates (Abel 1977, 1984; Kubly 1983; Bradford *et al*. 1998; Kratz *et al*. 1994; Stoddard 1987; Taylor and Erman 1980; and Knapp et al 2001), known invertebrates have not been compiled into a master list. The broad taxonomic groups studied include both benthic invertebrates (primarily aquatic insects) and zooplankton. There are no known listed or sensitive aquatic invertebrates in these parks though some species merit special attention due to their scarcity.

The primary threats to native aquatic wildlife include predation, competition and genetic introgression from exotic species. Thirteen vertebrate species have been introduced to the parks' aquatic environments and at least nine of these have become established. At least one aquatic invertebrate and several plants have been introduced into park waters. There is serious concern about the introduction of contaminants, especially biocides and pollutants from internal-combustion engines. Some native aquatic species are declining (e.g., two species of mountain yellow-legged frogs, *Rana muscosa* and *Rana sierrae*). There has been some anthropogenic alteration of aquatic habitats and there has been some harvest of select aquatic species.

SENSITIVE SPECIES

The parks support a rich and diverse vascular flora of over 1,200 species (and more than 1,560 taxa, including subspecies and varieties). Of these, 150 taxa are identified as having special status. The term "special status" is applied here to include taxa that are state- or federally-listed, considered rare or threatened by the California Natural Diversity Database (CNNDB) or the California Native Plant Society (CNPS), or at risk because they have a limited distribution.

Only one species from the parks is listed under the state or federal endangered-species acts: *Carex tompkinsii*, also known as Tompkins' sedge, is listed as rare under the California Endangered Species Act. One species (*Pinus albicaulis*, whitebark pine) is under review for federal endangered listing. In addition, 83 plant taxa documented as occurring in SEKI are considered imperiled or vulnerable in the state by the California Department of Fish and Game's California Natural Diversity Database. An additional 66 taxa in SEKI, not formally listed by CNDDB, are recognized as having special status because their distribution is restricted to the Sierra Nevada. Special-status plants are distributed throughout the two parks and inhabit a wide range of environments along the length of the elevation gradient that characterizes the landscape.

AIR RESOURCES

Air pollution is one of the most serious external threats to Sequoia and Kings Canyon National Parks. The parks have some of the worst air quality in the National Park Service and air pollution threatens the health and welfare of park resources, park staff, and visitors alike. Current research and monitoring indicates that ozone (also known as smog), nitrogen deposition, pesticide drift, and regional haze (particulate matter) pose the most serious threats, though future research may reveal even greater threats as yet unknown. The National Park Service Organic Act and the Clean Air Act mandate that these parks protect park resources and air quality related values from the adverse impacts of air pollution.

Much of the parks' air pollution originates in the San Joaquin Valley and is transported into these parks by prevailing winds (Roberts et. al. 1991). Three main factors contribute to the area's high pollution levels: climate, human activities, and topography. Hot, dry summers create perfect conditions for smog formation. A spread-out, car-dependent society with the highest population growth in the state produces increasing numbers of mobile and small stationary emission sources. Bowl-like topography promotes nightly temperature inversions that trap and concentrate pollutants and subsequently move upslope into the Sierra Nevada.

Unlike many other states, California has few large stationary sources of air pollution; mobile, area, and small stationary sources emit the majority of the state's pollutants. Mobile sources contribute approximately 70% of the precursors to ozone production (2006 California Almanac). Mobile sources and agricultural activities together account for most of the direct PM10 emissions (particulate matter ten microns in diameter or less). Vegetation (especially cotton, alfalfa, beans, tomatoes, pines and oaks) may emit up to 70% of the hydrocarbons involved in ozone and organic particle formation.

CULTURAL RESOURCES

In addition to their rich natural diversity the parks preserve a rich, and by definition, unique cultural record of prehistoric and historic resources. It is estimated that seven percent of the parks' collective acreage has been inventoried (surveyed) for the presence or absence of cultural resources. This figure translates into approximately 78,000 acres.

The earliest systematic inventories of cultural resources date from the late 1950s and early 1960s. Previous investigations, including interviews with California Native American Indians and early settlers, were infrequently conducted; these early investigations tended to focus on the most highly visible sites and included extrapolations of knowledge from outside the parks. However, the compliance inventories of the mid-1960s to 2007 were more widely focused; they have expanded the knowledge base of known cultural resources within the parks to 536 prehistoric sites and 135 historic sites. This current database represents the best available information on the range of site types and human activities carried out over time in Sequoia and Kings Canyon National Parks (see Appendix H).

The parks' known cultural resources span a time period of at least 5,000 to 7,000 years. These resources document prehistoric, historic, and even contemporary use throughout much of the parks. The cultural resources run the gamut from well-defined and effectively "permanent" bedrock mortars (grinding holes) to log or lumber structures susceptible to fire to pictographs (rock art) to expansive vistas and wild plant resources. Of note, the two latter resource types are used by contemporary California Native American Indians for spiritual or cultural purposes.

Prehistoric Resources

Prehistoric cultural resources are those human-made sites, structures, features, or objects which pre-date the arrival of European or American explorers or settlers. By definition then, they are synonymous with Native American (American Indian) use. At the time of the first Spanish movements into the Great Central Valley of California (circa 1800), the native groups living in the valley and the western foothills of the Sierra Nevada were the Foothill Yokuts and Monache Indians (the latter also being known as the Western Mono). Prehistoric site types within the parks include small villages, campsites, lithic scatters (obsidian mostly), bedrock mortars and basins, caves, stone circles and stone hunting blinds, pictographs and petroglyphs, and dark, midden soils marking the location of long-term human use or settlement.

Ethnographic Resources

Ethnographic resources are recognized as including combinations of natural resources and standard cultural resource types. The distinction traditionally made by agency managers between natural and cultural resources may not apply when focusing on ethnographic resources. These latter resource types can be locales where subsistence or religious (ceremonial) activities are conducted, by either groups or individuals. Ethnographic resources include sites, structures, objects, and landscapes that are assigned cultural significance by traditional users. Ethnographic resources within the parks can include such things as historic villages or campsites, caves, pictograph sites, traditional plant gathering areas, graves, landscapes, vistas, and other natural features (e.g., granite monoliths and natural promontories).

Historic Resources

Historic resources are those human-made sites, structures, features, or objects which date from the time of the arrival of European or American explorers and settlers up until the middle of the 20th century (that is, they must be at least 50 years of age). Historic sites can be of Native American association but are most often associated with Euro-American use and occupation.

Aspects of all of the episodes of historic activity in the southern Sierra Nevada can be found in historic sites within the parks. The associated site types include cattle camps, trails, sawmills, logging camps, sequoia stumps, shake piles, hard rock mines and mining features, stone quarries, trash dumps, hydroelectric dams and water flumes, the Colony Mill Road, military campsites, Civilian Conservation Corps-era ranger stations and roads, and, most-recently, NPS-constructed "Mission 66" facilities.

DEVELOPMENTS AND INFRASTRUCTURE RESOURCES

The park has five major developed areas with approximately 1,064 buildings in five sub-district areas. The development zone area in the park is about 1,000 acres in total size. The quality of the buildings range from well-planned modern buildings that were adequately designed for protection against wildland fires to several hundred old buildings that are at risk of being significantly damaged or destroyed by fire. The total replacement value of the buildings within the park is well above $200 million. Serving the developed areas are about 152 miles of paved and unpaved roads. There are uncounted miles of above ground powerlines and telephone lines within four of the five developed areas that are primarily at risk of significant damage or destruction from unwanted wildland fires.

All five developed areas in the parks have significant wildland/urban intermix fire threats. The fire management program has been working for many years on mitigating these threats by using a combination of mechanical hazard abatement near the buildings and prescribed burning to create wide buffer zones around the developed areas.

9. Historic Role of Fire

PRIOR TO EUROAMERICAN SETTLEMENT

The presence of fire has played a pivotal role in shaping ecosystems and landscapes in the Sierra Nevada for many millennia (Davis and Moratto 1988; Smith and Anderson 1992; SNEP 1996; Anderson and Smith 1997). As a keystone ecological process it governs aspects of ecosystem dynamics such as soil and nutrient cycling, decomposition, successional pathways, vegetation structure and composition, biodiversity, insect outbreaks, and hydrology (Kilgore 1973; SNEP 1996). Historically, fire frequency, size, intensity, and severity varied spatially and temporally across the landscape depending upon number of ignitions, climate, elevation, topography, vegetation, fuels, and edaphic conditions (Skinner and Chang 1996). Fires were a common occurrence on the landscape, often burning for months at a time and reaching large sizes.

Episodic fire occurrences performed many ecological functions within Sierran ecosystems prior to Euro American settlement. Frequent surface fires in many vegetation types minimized fuel accumulation while their variable nature helped create diverse landscapes and variable forest conditions (Stephenson et al 1991; SNEP 1996). Fires tended to be of low to moderate severity, with high-severity patches (fire sufficiently intense to kill most large trees) generally restricted to localized areas of a fraction of an acre to several acres–infrequently larger–in size. Extensive research in mixed conifer forests has shown that low intensity surface fires were a common occurrence and tended to keep the forests open (Biswell 1961; Weaver 1967, 1974; Hartesveldt and Harvey 1967; Kilgore 1971, 1972; Harvey et al 1980).

Many species and most communities show clear evidence of adaptation to recurrent fire, demonstrating that fire occurred regularly and frequently. This is particularly true in the chaparral and mixed conifer communities, where many plant species have life history attributes tied to fire for their reproduction or as a means of competing with other biota. Fire damaged or killed some plants, setting the stage for regeneration and vegetation succession. Many plants evolved fire-adapted traits, such as thick bark, and fire-stimulated flowering, sprouting, seed release, and/or germination (Chang 1996). Fire influenced soil and forest floor processes and organisms by consuming organic matter and inducing thermal and chemical changes. It also affected the dynamics of biomass accumulation and nutrient cycling at a variety of spatial scales. These effects in turn influenced habitats, distribution, and occurrence of many species (plants, vertebrates, and invertebrates).

The near exclusion of widespread low- to moderate-severity fire beginning in the latter half of the nineteenth century drastically affected the structure and composition of most Sierra Nevada vegetation, especially low- to middle-elevation forests. The changes are widespread and the effects are still poorly understood. The most obvious changes are increases in tree density and changes in biodiversity (Parsons and DeBenedetti. 1979; McKelvey et al. 1996). Shade tolerant species such as white fir have increased in density over shade intolerant species such as Jeffrey pine and sugar pine. Forests today are denser, with a higher proportion of smaller trees, and with an increased dominance by white fir and incense cedar. These changes have increased the levels of fuel, both on the forest floor and "ladder fuels"—small trees, branches, and brush which can carry fire into the canopy, as well as changing fuel flammability (Schwilk and Caprio 2011). Increases in fuel, coupled with efficient suppression of low and moderate intensity fires, have led to an increase in general fire severity. Crown fires were rare or absent from Sierra sequoia-mixed conifer forests prior to Euro American settlement (Show and Kotok 1924; Kilgore and Taylor 1979). In contrast, in contemporary forests the probability of extensive crown fire or lethal scorch has increased significantly (Bonnicksen and Stone 1978; Kilgore and Sando 1975). The 1955 McGee and the 1987 Pierce fires in sequoia-mixed conifer illustrate these changes in the fire regime.

FIRE REGIMES

Attributes of pre-Euro American fire regimes can provide vital reference information for understanding changes in ecosystems over the last 150 years and in developing goals for the restoration of fire. The concept of a fire regime allows us to view fire as a multi-faceted variable rather than a single event within an ecosystem (Whelan 1995). Thus areas can be classified as having a certain type of regime that summarizes the characteristics of fires, within some range of variability that can have both spatial and temporal attributes. The idea also allows us to estimate if human activities have altered fire regimes, and to what extent. This information helps facilitate decision making on what management actions are needed to preserve or restore the regime such as whether a particular vegetation type is or can be managed to be more "resistant" or "resilient" to the effects of fire and a changing climate. Fire regimes are normally defined according to specific variables including frequency, severity, season, duration, magnitude, spatial distribution, and type of fire (Gill 1975; Heinselman 1981, Bond and Wilgen 1996). These fire regime characteristics may vary through time and across the landscape in response to climatic variation, number of lightning ignitions, topography, vegetation, specific historic events, and human cultural practices (SNEP 1996).

Common fire regime types for major park vegetation communities can be broadly defined as:

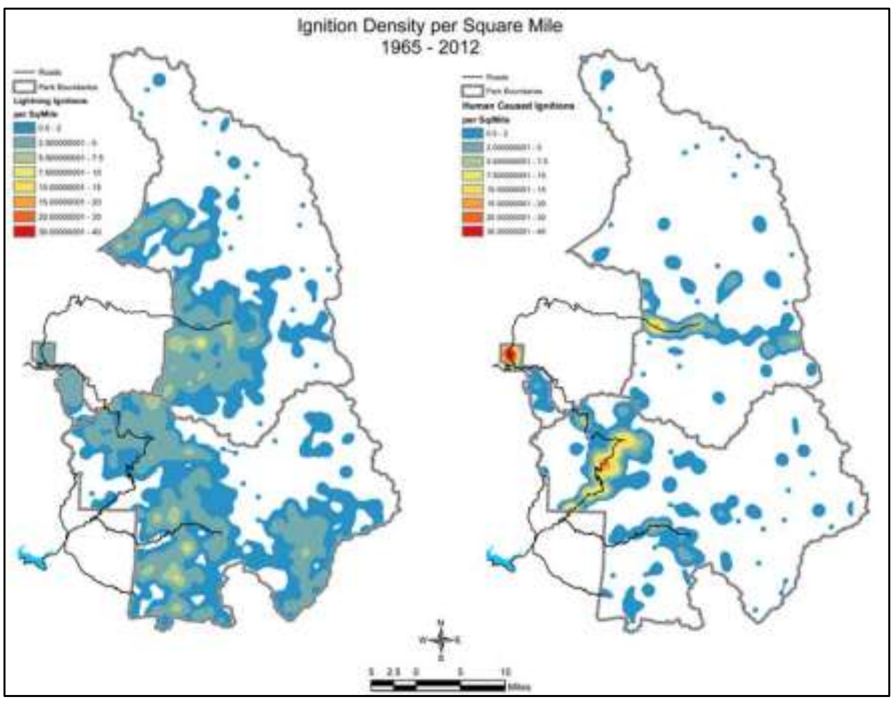
- Short-interval, low-intensity surface fires: These fires burn regularly and frequently and, as such, rarely allow organic fuels to accumulate to a point where high-intensity fires may develop (van Wagtendonk 1972). Examples would include ponderosa pine and blue oak woodlands.
- Moderate interval, stand-replacing fires: These fires occur at moderate frequencies but at high intensities. The principle example within the parks would be chaparral vegetation, where species tend to be sprouters and or obligate seeders. Increasing fire frequencies in this vegetation can result in rapid type conversion.
- Variable-interval, variable-intensity surface fires: These fires usually spread slowly and rarely crown. Much of the upper montane red fir forest would fall in this category.
- Long-interval, low-intensity surface fires: These fires usually spread slowly or not at all, and rarely burn the crowns or kill stands of overstory trees (Kilgore and Briggs 1972). Examples of this regime type in the Sierra Nevada are the subalpine forests of whitebark pine (*Pinus albicaulis*) and some foxtail pine (*Pinus balfouriana*) stands. The effects of fire vary with species, stand age, and fire intensity.
- Long-interval, high-intensity surface fires: These fires burn rarely, but become high-intensity, possibly stand-replacing. For the Sierra Nevada, piñon pine might fit this category.
- Long-interval, variable intensity fires: These fires are uncommon events and exhibit considerable spatial variability in intensity depending on fuel and weather conditions. Infrequent fires in some lodgepole pine forests (*Pinus contorta* var. *murrayana*) may be characterized by low intensity surface fires or, under severe burning conditions, high severity crown fires.
- Lack of fire: Within a specific areas or vegetation types fire probably did not occur or its occurrence was extremely rare and erratic. Examples might include alpine vegetation, western juniper, and isolated foxtail pine stands (stands not connected to lower elevation forests) where, if fire occurred at all, it would usually only burn the single tree that was ignited. Evidence for the

long absence of widespread fire in these stands comes from the great age of many individuals of this fire sensitive species and from the extensive amounts of subfossil wood, often exceeding 4,000 years in age, found on the ground (stands such as Alta Peak, Tablelands, or Tawny Point provide examples).

IGNITION SOURCES

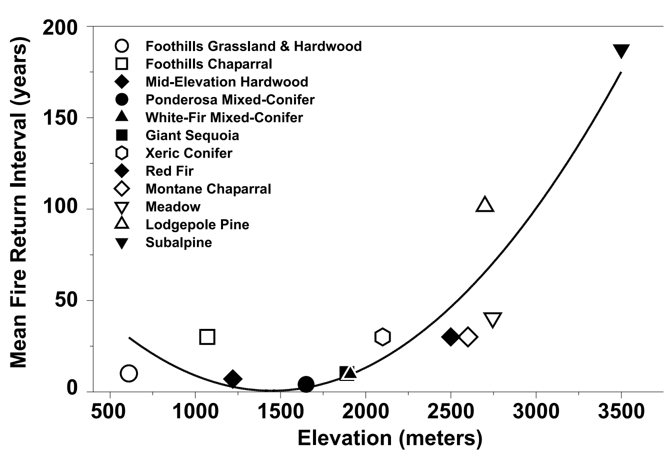
There is considerable spatial variation in contemporary lightning ignition rates within the parks. Based on data from the parks' fire records over the last 70 years (Vankat 1985; NPS GIS data), ignition densities cluster in areas above Cedar Grove, the Kern Canyon, Sugarloaf Valley, and the western slopes of the Great Western Divide (Figure 9-1). Standardizing for land area, lightning ignition rates are lower than expected at lower and at higher elevations and higher than expected at mid elevations particularly in white fir, red fir, and Jeffrey pine vegetation types. However, while contemporary lightning ignition rates are lower in lower elevation conifer areas, areas where historic fire return intervals were the shortest; past fire sizes at these elevations were probably greater than at higher elevations due to greater rates of fire spread.

Figure 9-1: Map of Lightning and Human Caused Ignitions



Ignitions of pre-Euro American settlement fires are usually attributed to either lightning or ignitions by Native Americans. In the Sierra Nevada authors typically refer to a background level of lightning ignitions that were complemented by Native American sources (Lewis 1973; Kilgore and Taylor 1979). However, while there is good evidence that Native Americans started fires from a variety of sources (Reynolds 1959; Lewis 1973;Anderson 2006) considerable debate remains on the importance of this type of burning at a landscape scale (Vale 2002; Barrett et al 2005. It undoubtedly influenced vegetation patterns, although probably on a local basis determined by proximity to camping, hunting, or other resource use areas. Within the parks the reasons, timing, and sizes of Native American burning are poorly understood. Current hard historic evidence on the source of fires in the southern Sierra Nevada is too limited to determine the specific importance of either lightning or Native American causes. Actual patterns of fire across the landscape were probably a result of both ignition sources with the importance of each varying between specific vegetation types and locations. However, within the parks it is argued that the number of lightning ignitions could account for the observed pre-settlement fire frequencies at most locations if they had not been suppressed and had been allowed to spread (Swetnam et al 1992; Stephenson 1996; Vale 1998). This contrasts with views which suggest that lightning ignitions were not frequent enough to account for the number of fires that occurred in the Sierra prior to Euro American settlement (Reynolds 1959; Vankat 1970; Lewis 1973; Kilgore and Taylor 1979). The former view is supported by an analysis of past fire occurrence, reconstructed using fire scars, and contemporary lightning ignitions in the East Fork watershed (Caprio 2003 unpublished data, 2004). For the period from 1750 to 1849 fires were recorded during 75% of the years (25% without fires) while during the contemporary period from 1933 to 1999 lightning ignitions (243 total) were recorded for 79% of the years (21% without ignitions), a similar frequency. While specific locations within the watershed had high pre-Euro American settlement fire frequencies and few recent ignitions there are no apparent barriers to fire spread from areas with high ignition rates. The one exception being conifer forests on Milk Ranch Peak, isolation by chaparral vegetation from the rest of the watershed, but which had very frequent fire and few lightning ignitions

Figure 9-2: Relationship between Fire Frequency and Elevation



Fire Frequency

General patterns of pre-Euro American fire frequencies are apparent at several scales within the parks. Variation exists locally, with specific site characteristics, such as productivity, potential for ignition, or other factors, influencing frequency. General patterns are also apparent at large scales. For example, differences in average fire frequency are apparent in different vegetation types (Table 9-1). Additionally, on the west slope of the Sierra, frequencies reconstructed using fire-scarred trees show an inverse relationship between number of fires and elevation (Caprio and Swetnam 1995; Swetnam et al 1998; Caprio 2000). When all available information about fire occurrence for all major vegetation types in the parks (including vegetation types where fire scars are not found) are considered the relationship between fire frequency and elevation has a pronounced "Lazy-J" shaped relationship (Figure 9-2) (Caprio and Lineback 1997). Fire return intervals are longest at higher elevations, shortest in lower mixed conifer forest and appear to again increase in length in lower elevation grass-oak woodland and chaparral vegetation based on current, albeit poor quality, information.

Table 9-1: Fire Frequencies for Different Vegetation Types

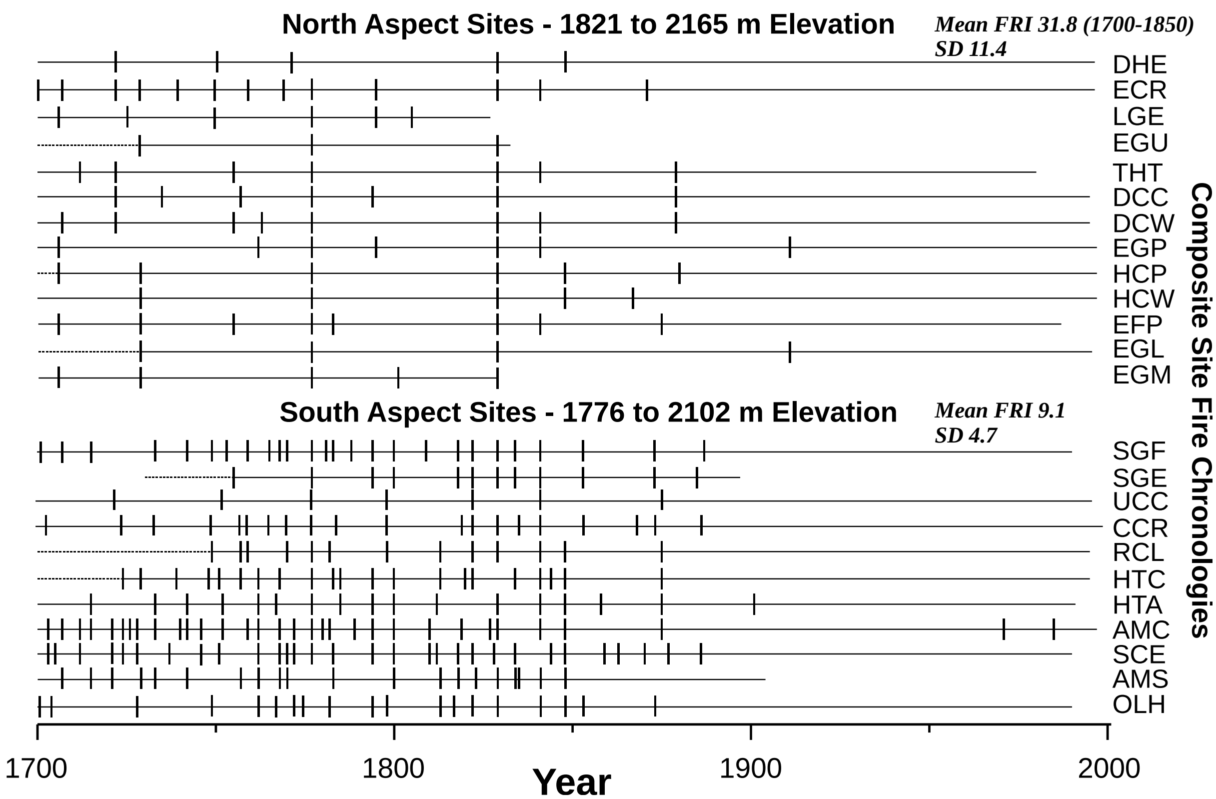
Vegetation/Terrain Class (class code #)	Code	Mean	Max.	Freq. Class	Knowledge	Reference
(1) Ponderosa Mixed Conifer	PIPO	4	6	v. high	good	1,2,3,16,177
(2) White Fir Mixed Conifer	ABCO	10	16	high	good	1,2
(3) Red Fir Mixed Conifer	ABMA	30	50	low	poor	1,4,5
(4) Lodgepole Pine Forest	PICO	102	163	v. low	v. poor	5,6,18
(5) Xeric Conifer Forest	XECO	30	50	low	v. poor	5,7,8,17
(6) Subalpine Conifer	SUAL	187	508	v. low	poor	5,9
(7) Foothills Hardwood & Grassland	FHGR	10	17	mod.	v. poor	5,10,11
(8) Foothills Chaparral	FOCH	30	60	low	estimated unknown	12
(9) Mid-Elevation Hardwood	MEHA	7	23	mod.	v. poor	3,19
(10) Montane Chaparral	MOCH	30	75	low	estimated unknown	12
(11) Meadow	MEAD	40	65	low	estimated unknown	8
(14) Giant Sequoia Forest	SEGI	10	16	high	good	13,14,15
(12) Barren Rock	ROCK					
(13) Other (mostly water)	OTHR					
Missing Data	MISS					

Note: Mean and maximum fire-return intervals for the 12 major classifications in Sequoia & Kings Canyon National Park. Data are for the period prior to 1860 (1870 for subalpine conifer). The primary source(s) for the data are enumerated under "Reference" heading and are listed at the bottom of the table. Fire frequency regime classes for each major vegetation class were based on mean maximum fire-return intervals. The frequency classes were used to reconstruct fire frequency regimes spatially across the park.

1 Caprio and Swetnam 1993, 1994, 1995; 2 Kilgore and Taylor 1979; 3 Stephens 1997, unpublished data in Skinner and Chang996; 4 Pitcher 1981,1987; 5 Caprio unpublished data 2000 ; 6 Keifer 19917 Taylor, unpublished data in Skinner and Chang 1996; 8 Skinner, unpublished data in Skinner and Chang 1996; 9 Caprio, Mutch, and Stephenson unpublished data ; 10 Mensing 1992; 11 McClaren and Bartolome 1989; 12 SNEP 1996; 13 Swetnam et al. 1991; 14 Swetnam et al. 1992; 15 Swetnam 1993; 16 Warner 1980; 17 McBride and Jacobs 1980; 18 Sheppard 1984; 19 Stephens 1997

Additionally, within at least some watersheds strong differences in fire frequency exist between aspects. In the Redwood Mountain area, which is sequoia-mixed conifer, fire occurred about every nine years on west-facing slopes and every 16 years on east-facing slopes before 1875 (Kilgore and Taylor 1979). In the East Fork differences are more pronounced with fire 2-3 times more frequent on south than on north aspects at similar elevation sites (Fig. 9-3) (Caprio 2004).

Figure 9-3: North and South Aspect Fire Frequencies in the East Fork



Another important component of fire frequency statistics is the stochastic variation in fire intervals through time (fire interval distributions) among or within vegetation types. For example, areas with a similar mean fire return interval could have quite different fire interval distributions. One site might have very regular intervals between fires while a second site might have very irregular intervals. Such interval dependent effects of fire events can have significant influences on plant demographics and long-term plant community structure (Whelan 1995; Bond and van Wilgen 1996; Chang 1996).

Magnitude

Fire characteristics, such as intensity and severity, also varied among vegetation types. At lower elevations, little is known about fire regimes in grasslands and oak woodlands due to the lack of fire scarred trees and the replacement of nearly all native herbaceous communities by exotics following initiation of intense grazing in the 1860s (Dilsaver and Tweed 1990). However, descriptions of the vegetation suggest that episodic fast moving surface fires in flashy herbaceous fuels, during the dry summer/fall, probably played a role in these communities (Parsons 1981). Stand replacing fire in chaparral communities today probably differs little from pre-Euro American characteristics although frequencies have probably been altered. In much of the Sierra's sequoia-mixed conifer forest, fires were primarily non-stand replacing surface fires prior to Euro American settlement (Show and Kotok 1924; Kilgore and Taylor 1979; Warner 1980; Pitcher 1987; Caprio and Swetnam 1995). Instances of large stand replacing fires do exist in particular mixed-conifer locations (Caprio et al 1994) but are uncommon. Fires in these areas were dominated by low to moderate severity, with high-severity generally restricted to localized areas (Stephenson et al 1991). Characteristics of past fire appear to have been somewhat different in higher elevation forests. Fire in red fir forest was typically non-stand replacing due to the fire resistant bark of this species but significantly sized patches of trees could be killed, particularly on higher elevation north aspects (Pitcher 1981; 1987). Fire in lodgepole pine was generally a patchwork of low intensity surface fire and higher intensity crown fire (mixed severity) depending of specific burning conditions (Caprio 2006, 2008) that varied depending on site moisture conditions (Caprio 2004a, 2004b).

Fire Size

The scale of fire prior to Euro American settlement was significantly different from what is typically observed today. Both the frequency of fire occurrence and the frequency of large spreading fires were much greater than today or at any time in the last hundred years. Estimates based on fire history data suggest that from 15,100 to 24,700 acres burned annually within the parks (Caprio and Graber 2000). However, because of the vagaries of climate or number of ignitions, the actual number of acres burned in any given year could have been much greater or much smaller than the average. Coarse reconstructions of actual pre-Euro American settlement fire sizes in the Kaweah's East Fork watershed indicate that up to ~10,400 acres (33%) of the 31,870 acre watershed burned in a given year (this may have been one or more fires in the year 1829) (Caprio 2004). Of interest is that some of these fires also burned in adjacent drainages. For example fires in 1777, 1812, 1841, and 1875 are all recorded in the South Fork, East Fork, and Middle Fork of the Kaweah River, indicating potential spread of fires among watersheds. However, most fires in the East Fork were small with a roughly estimated annual area burned of ~800 acres (2.4% of the area).

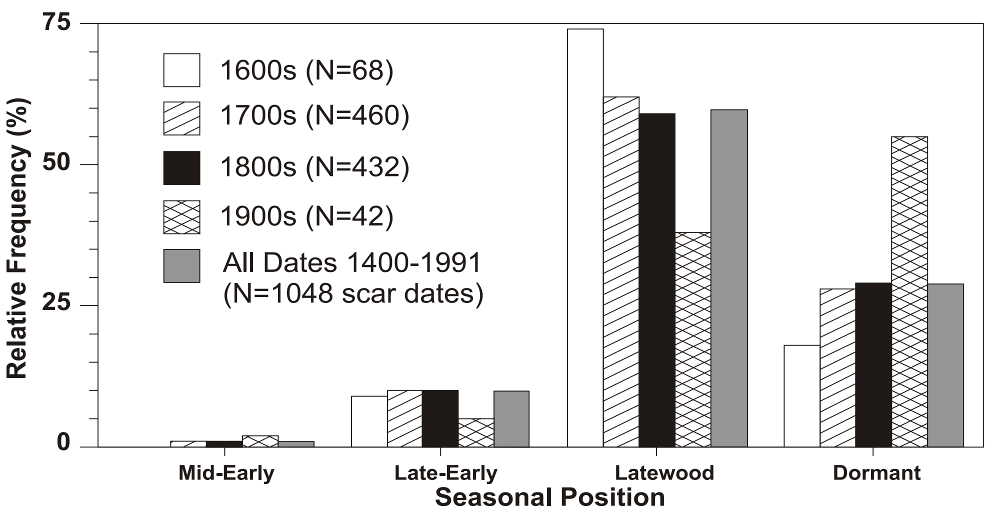
Fire history reconstructions suggest that variation in fire size also occurred by aspect (Caprio 2001, 2004). Within the East Fork watershed annual area burned prior to Euro American settlement on lower elevation south aspects (5,860 – 7,145 feet elevation) was generally small but regularly interspersed with years when moderate large fires occurred. In contrast, on similar north aspects, most fires seem to have been small but the pattern was punctuated by rare years when large areas burned.

Fire size was probably also related to overall landscape diversity patterns such as vegetation, fuel, and topographic complexity. In course-grained landscapes, such as the highly dissected, rocky high country (upper Kern and Kings River drainages) fires probably tended to be smaller with poor year-to-year synchrony. In contrast, fires were probably larger and more synchronous in fine-grained watersheds such as are found on the west side of the range. Burn patterns in these landscapes would be related to fire conductance among vegetation types and between drainages. For example, in the Kaweah watershed, fires would have the potential to spread for long distances during the long summer/fall dry season. Additionally, drainages such as the Kaweah have strong connections to lower elevation grasslands (now outside the parks) where ignitions could spread rapidly and reach large sizes before spreading into conifer forests.

Seasonality

Season of fire occurrence can have important effects on vegetation and wildlife. Factors that can be important in seasonality are fuel moisture content, phenology of vegetation, or life history patterns of wildlife. Vegetation and wildlife within particular ecosystems have generally adapted to fire within a particular window of time. It has been hypothesized that changes in fire seasonality that go outside the normal range of variability may have adverse impacts. However, recent studies suggest that initial restoration fires may have few or in some cases positive effects (Knapp et al. 2005, 2006, 2007; Ferrenburg et al. 2006; Schwilk et al. 2006). In the Sierra Nevada pre-Euro American settlement fires generally occurred from the summer through the fall based on analysis of seasonal positions of fire scars in tree rings (Swetnam et al 1992; Caprio and Swetnam 1995) (Figure 9-5). This agrees with current knowledge of contemporary lightning ignition and fire spread patterns (Show and Kotok 1924; Vankat 1985; Sequoia and Kings Canyon fire records).

Figure 9-4: Seasonal Position of Fire Scars by Century



Effects of Climate

Short-term climatic variation played a very strong role in influencing burn patterns and fire severity in the past. Historically, on the west slope of the Sierra Nevada specific regional fire years have been identified (years in which fires have been recorded at sites from throughout the southern Sierra Nevada). These usually occurred during dry years (Brown et al. 1992; Swetnam et al 1992; Swetnam 1993; Swetnam et al 1998; Taylor and Beatty 2005). The reconstruction of fire size in the East Fork watershed indicates large fires, burning throughout the watershed, primarily occurred during years when prior winters were dry while small to moderate sized fires could occur on south aspects during almost any given year (Caprio 2004). Analysis of millennial length fire histories from giant sequoia also document long-term variation (1,000-2,000 years) in the fire regime associated with climatic fluctuations (Swetnam 1993, Swetnam et al 2009). These data suggest more frequent but smaller fires during the Medieval Warm Period (A.D. 1000 - 1300) and fewer larger fires during cooler periods (A.D. 500 - 1000 and after A.D. 1300). These fluctuations indicate that characteristics of fire regimes are dynamic over long time periods. Thus long-term management should not be based solely on a static interpretation of the fire regime for a particular unit of land at a given time.

Post-Euro American Settlement Changes

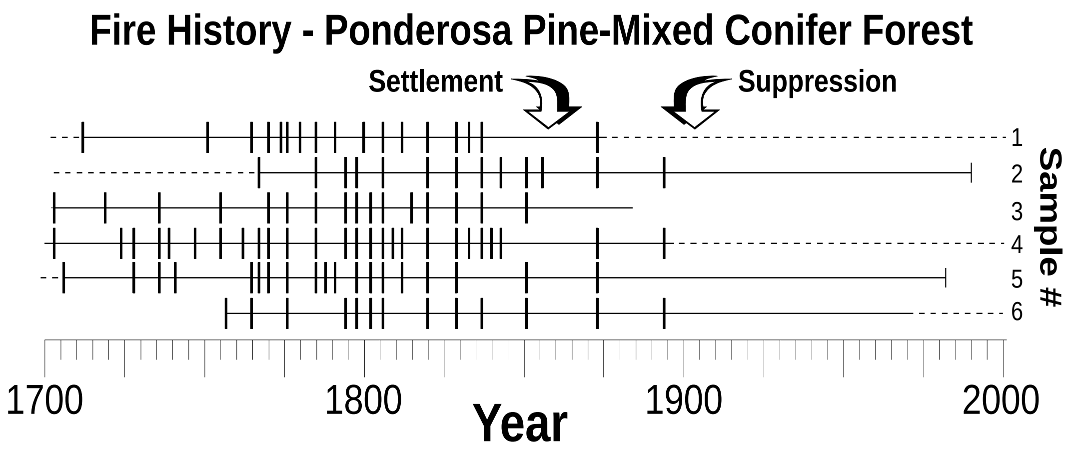
Literature on changes to pre-Euro American fire regimes often suggests that changes in these regimes are largely the result of active fire suppression activities. However, fire history reconstructions show that the most dramatic changes in Sierran fire regimes took place 40 to 70 years prior to the initiation of organized and effective suppression efforts in the first two to three decades of the twentieth century. By far the most dramatic changes appear to be a direct result of initial Euro American utilization and settlement of the southern Sierra between about 1850 and 1880.

Reconstructions of past fire occurrence from fire scarred trees in the parks show several periods of change between 1850 and 1921 (when written fire records for the parks begin). Between about 1850 and 1870 a dramatic decline in fire frequency occurred in nearly all lower to mid-elevation conifer forests. Between about 1870 and 1900 large landscape scale fires continued to burn although at a reduced frequency relative to pre-Euro American levels. Similar changes may have also occurred in lower elevation vegetation but fire history evidence is lacking in these vegetation types. In upper elevation areas, changes are also not apparent during this period due to the long natural fire return intervals. In the first decades of the twentieth century fire on the scale that had occurred prior to 1900 no longer existed.

The initial change in local fire regimes in the 1860s appears to be the result of either: 1) a decline in the influence of Native American populations and/or 2) the impact of intense grazing pressure on fine fuels, particularly at lower elevations, important for fire spread (Vankat 1970; Caprio and Swetnam 1995; Taylor and Beatty 2005, Swetnam et al. 2009).

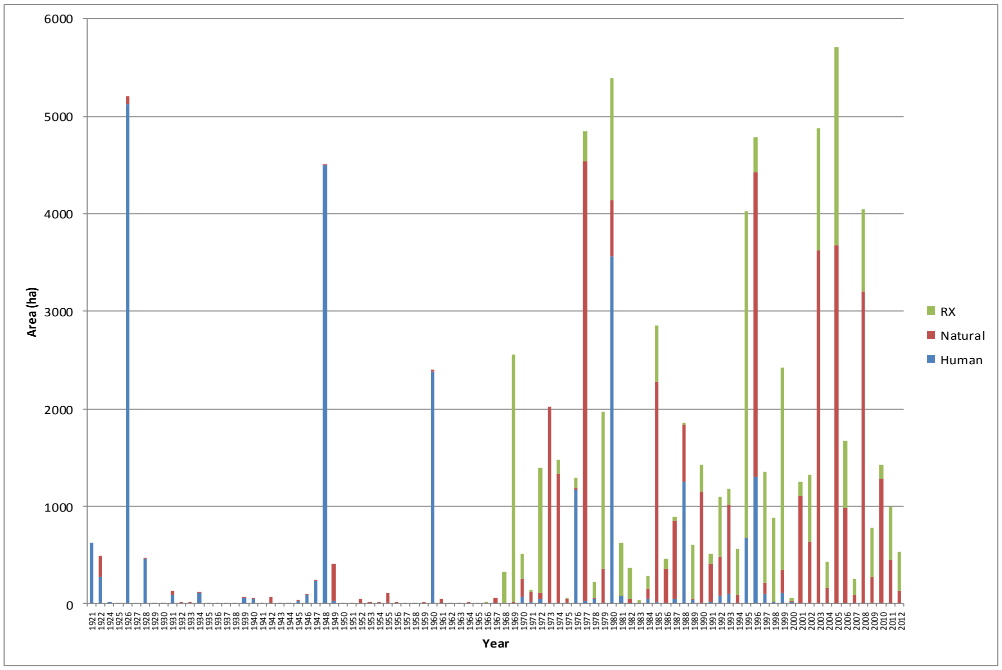
Literature on fire and human impacts on the Sierra Nevada during the latter half of the 19th century often mentions the extent and impact of fires set by sheep herders (Vankat 1977; Beesley 1996; Kinney 1996). The indicated purpose of the burns, set in the fall as the flocks moved out of the mountains, was to improve forage and remove barriers to sheep movement. It is also frequently mentioned that fires were of unnatural intensity (Muir 1877; Muir 1938). However, this picture of large scale burning by shepherds is not supported by fire history sampling that has been carried in the parks or other locations on the western slope of the southern Sierra (Swetnam et al 1992, Caprio and Swetnam 1995; Swetnam et al 1998; Caprio 2004). Of the large number of fire history chronologies developed in this area nearly all show a dramatic decline in fire frequency in about 1860 (Figure 9-5). However, there is evidence of limited anthropogenic burning, particularly around meadows (Caprio in press). While sporadic fires, which continue to appear in the fire scar record up until about 1900, could have been set by shepherds their ignition source(s) remains unknown.

Figure 9-5: Decline in Fire Frequency Around 1860



Effectiveness of fire suppression in the first half of the twentieth century varied spatially over the landscape. Suppression efforts had their greatest impact in the middle-elevation zones where low- to medium-intensity surface fires were more easily controlled. In contrast, fast-spreading fires typical of chaparral sites were often beyond the control of humans and were less successfully suppressed (Chang 1996). Fire records from in and near the parks show a substantially higher proportion of large fires in grass/oak woodland and chaparral than in mid-elevation conifer forest through the 1930s. Active fire suppression of all fires continued until 1968 when the first large scale prescribed burn was carried out in the parks. This was soon followed by a policy shift that permitted some lightning ignitions to burn naturally. Since 1968 a substantial amount of area has been burned either through active management ignitions or lightning ignitions allowed to burn (Figure 9-7).

Figure 9-6 – Area Burned Through Rx, Natural, and Human Ignitions



10. Wildland Fire Management Situation

FIRE SEASON AND HISTORICAL WEATHER SUMMARY

The fire season, as determined by FireFamily Plus analysis of wildland fire occurrence and weather patterns, runs from May 15 to October 15, with an average of 50 to 100 fires of all origins occurring during this period. July, August, and September have the highest fire incidence. Weather tends to be clear with daytime temperatures ranging approximately 75° to 85° F at 5,000 feet in elevation and 85° to 105° F at 1,000 feet. Prevailing winds are about five to ten miles per hour from the west and southwest.

The prevailing westerly wind brings marine air into the San Joaquin Valley that is heated and subsequently raised by the steep rise of the Sierra to the east. As a result, afternoon thunderheads are common during the hottest weeks of the year, from mid-July to the end of August. At other times of year, thunderstorm activity is generated by flows of southerly subtropical moisture. Periods of high lightning activity often last three to four days and possibly ignite 10 to 20 or more fires in the 4,000 to 8,000 foot elevations of the parks during one of these periods.

The parks receive their precipitation, depending on elevation, almost entirely from winter cold-front passages from the northwest and west. Virtually no precipitation occurs during the summer and fall, except during thunderstorms. Rarely, tropical storms from the Gulf of Mexico drop as much as four to six inches of rain in a few days during the summer and fall.

The topography of the parks results in a variety of local wind conditions. The diurnal relationship between heating and cooling of slopes and canyons results in local winds that can become significant to fire behavior. Narrow canyons, such as the South Fork of the Kings at Cedar Grove, typically produce summer afternoon up-canyon winds of 10 to 20 mph. Steep slopes result in nighttime down-slope and down-canyon winds. The occurrence of mid-slope thermal belts is common from mid-July to mid-October and can result in fires actively burning well into the night. This phenomenon was well evidenced on the 2003 West Kern Fire on the Kern River plateau and the 2010 Sheep Fire near Cedar Grove. It is estimated that nearly half of the growth of these fires occurred during nighttime hours as opposed to the normal afternoon burning period.

Thunderstorms can produce strong, erratic downdraft winds, which follow topographic features and can cause rapid spread of fire in all directions. Another potential source of strong winds is the rare foehn-like mono wind of late summer and fall. These gale force east winds are warm and dry, originating from the Great Basin. The high mountain crests of the Great Western Divide and High Sierra usually prevent these strong winds from reaching the surface within the parks. When these systems are well established, the strong and dry east winds aloft are frequently accompanied with extremely dry conditions and poor nighttime humidity recovery. Maximum relative humidity may not exceed 25% and can actually go down to single digits overnight.

The predominate summer weather scenario consists of a high pressure system that settles over the western United States and produces good visibility, high temperatures, low humidities, and atmospheric instability with gusty winds. Relative humidities in the mid-teens and low-twenties are common during these long periods of strong high-pressure dominated weather. There is some speculation that oscillation in the relative humidity in these parks results from fluctuations in the boundary between the moist marine layer to the west and the dry high-pressure area to the east. As a result, prescribed conditions can disappear quickly, and nighttime humidity recovery may be less than expected when the high pressure dominates.

The atmosphere tends to be unstable during the spring and becomes more stable during the fall. The San Joaquin Valley develops an inversion during the fall as the atmosphere cools, and agricultural "no burn" days below 5,000 feet are common. As the atmosphere over the parks becomes more stable, the probability that smoke will impact a popular vista or a local community becomes more likely.

Steep canyons also develop strong inversions, leading to potentially explosive conditions when they lift, as demonstrated by the 2005 Comb Fire in the Kings Canyon at Cedar Grove in which several thousand acres of brush and timber burned during the months of August and September. Strong inversions would trap smoke in the canyon at night with repeated episodes of rapid up canyon movement which would occur after these inversions would dissipate by mid-morning.

WILDLAND FUELS AND FIRE BEHAVIOR

Fire in the Sierra Nevada plays an important role in determining the structure of the various vegetation types (Table 10-1). Each vegetation type has evolved in the presence of a distinct fire regime. The vegetation of the parks generally changes along an elevation gradient. In general, the vegetation types, elevations, behavior, and corresponding fuel models are:

Table 10-1: Vegetation Types, Elevations, Fire Behavior, and Fuel Models

Vegetation Type	Elevation Range	Fire Behavior	NFFL Model	Scott / Burgen	NFDRS Model
Grassland (montane meadows, etc.)	6,000-11,000′	Rapid Spread Low Intensity	1	GR-1 GR-2	L
Grass with Overstory	1,400-6,000′	Rapid Spread Moderate Intensity	2	TU-4	C
Tall Brush (chamise & manzanita)	1,400-5,000′	Rapid Spread High Intensity	4	SH-5	B
Low Brush	1,400-6,000′	Moderate Spread Moderate Intensity	5	GS-2 SH-1	F
Medium Brush (decadent)	6,000-10,000′	Rapid Spread Moderate Intensity	6	SH-5	F
Closed Timber (short needle – slow spread)	5,000-11,000′	Slow Spread Moderate Intensity	8	TL-1 TL-2	H
Broadleaf Deciduous Hardwood & Long Needle Pine	4,500-7,000′	Moderate Spread, Moderate Intensity	9	TL-6	W, E
Heavy Timber Litter	4,500-8,000′	Moderate Spread High Intensity	10	TU-4 TU-5	G
Low Elevation Short Needle Conifer (SEKI custom model)	6,000-10,000	Slow Spread Moderate Intensity	14	TU-1 TU-4	G
High Elevation Short Needle (slow spread) (SEKI custom)	7,500-11,000	Slow Spread Moderate Intensity	18	TU-1	H

This generalized vegetation continuum varies with changes in aspect and local microclimates (springs, riparian zones etc.). More extensive fires occur in drought years, with the fires spreading into areas normally too wet to burn.

Fuel models are simply mathematical models that describe the properties of live and dead vegetation that contribute to the physics of combustion. The models include parameters such as fuel weight, density, horizontal and vertical continuity, moisture content, and flammability. Fuel models are primarily used to predict fire behavior under different weather and environmental conditions. Currently the Fire Behavior Prediction System (FBPS) contains 40 standard fuel models described by Scott and Burgan (2005) and as well as the original 13 standard fuel models described by Anderson (1982). In the past, the park has also created another two custom fuel models to describe fuel complexes not well covered by the standard 13 models. National Fire Danger Rating System (NFDRS) fuel models are also used to track seasonal drought and associated fire danger response planning. Table 10-2 provides a crosswalk between NFDRS and FBPS fuels models best used to describe fire behavior in the parks.

EFFECT OF FIRE SUPPRESSION ON WILDLAND FUELS

Dead fuel loads in the various vegetation types in the parks vary according to fire history, elevation, growth pattern, aspect, and length of growing season. The fire cycle, fuel load, and vegetation type are closely interrelated, and each fire type serves to stabilize and perpetuate a given community. Conditions produced from fire suppression have given rise to new fuel-vegetation complexes that influence fire type, which in turn affects the complex.

Years of fire suppression are thought to have effectively removed the mosaic of various aged burns in the vegetative communities below the red fir forest (< 8000 feet) and have encouraged more extensive fires than occurred prior to Euro American settlement. In the sequoia-mixed conifer and ponderosa pine types, fire acts as a thinning agent (Cooper 1960). In its absence, undergrowth of shade tolerant species results in a continuous ladder of all-aged crowns from surface to overstory. Crown fires, once virtually nonexistent in Sierra forests, are now possible (Kilgore and Sando 1975; Kilgore and Taylor 1979). The fires that occurred historically in the mixed conifer forest are thought to have been generally surface fires. A summary of the fire return interval for each vegetation type that occurs within the parks can be found in Chapter 9. Fire managers in the parks today use an index of how far an area has departed from the fire return interval that is thought to have existed prior to Euro American settlement (see FRID discussion in Chapter 4).

Control Problems

During the peak of the fire season, fires in the oak woodland fuels are usually controlled early with suppression resources (ground and air) or they burn up into the chaparral fuels.

Fires in the chaparral fuels frequently are beyond direct attack capabilities at the head once they become established. These fires usually burn up to the ridge top and are caught, as they become backing and flanking fires in typically 3-5 days.

Ponderosa pine-mixed conifer fires are often difficult to control during the peak fire season. Ladder fuels (manzanita and incense cedar) in the understory and numerous snags are the main cause of frequent short range spotting due to the torching of trees and rolling material in the receptive fine fuel bed. This fuel type is frequently located in a mid-slope thermal belt causing a longer period of active burning. The long burning period combined with the frequent spot fires can often exhaust initial action resources leading to extended attack (2-5 days).

Fires in the sequoia and white fir-mixed conifer types usually spread slowly through the compact litter layer and rarely escape initial action. Heavy fuel loads, steep slopes, and long burning periods usually cause the few fires that go beyond initial action. The heavy dead-and-down fuel and deep duff layer can lead to extended mop-up operations.

Fires in the red fir forest are rarely difficult to control due to the tightly compacted litter layer and slow fire spread. Fires occurring in the lodgepole pine and subalpine forest can usually be controlled due to the increasing amount of rock and bare ground as elevation increases.

FIRE MANAGEMENT HISTORY

Sources of fires

Thunderstorms account for an average of about 36 fires each year with most of these fires occurring in the mixed conifer type. Of the known lightning fires that have occurred in the parks from 1922 through the present, 95% of them have been less than 10 acres in size. Fire suppression has contributed to the preponderance of small fires; however, since the inception of the fire use program in 1968, approximately 89% of the fires being managed for resource benefit have been less than 10 acres. Most of these fires remained small because of low fuel loadings and natural barriers.

Lightning fire occurrence tends to increase with elevation up through the red fir type. Snags, ridge tops, prominent features, xeric sites, and the west facing slopes are frequent sites of lightning fires. The ridges above Cedar Grove and Kern Canyon, the Sugarloaf Valley, and the western slopes of the Great Western Divide, are areas of frequent fire occurrence during periods of lightning activity (Vankat, 1985).

Human-caused fires may occur almost anywhere and at any time. Most are concentrated around roads, campsites, and trails. Many are the result of accidents such as carelessness with cigarettes or unattended campfires, whereas a few, such as the 2-acre Lost Fire in 2001, are arson caused. Not including management ignited prescribed fires, since 1922, approximately 39% of the fires in the parks have been human-caused, mostly in mixed conifer forests. Starting in 1968, the parks began using prescribed fire as a forest management tool. These projects make up approximately 12% of the fires in the parks. Therefore after 1968, 61% of fires are caused by lightning, 27% are human-caused, and 12% are prescribed fires.

Fire Suppression

Little is known regarding fire suppression activity prior to the 1890 creation of Sequoia National Park and General Grant National Park (later expanded and renamed Kings Canyon National Park). Undoubtedly some level of suppression occurred by native peoples in pre-Euro American times, and there is some record of miners, sheepherders, and cattlemen extinguishing fires during their heyday beginning in the mid-1850's. Lighter fuel loads and more open forests - a product of frequent pre-settlement fires - probably allowed some level of success to those early suppression efforts. During that period fire control was aided by cattle and sheep which grazed down dry grasses, further reducing opportunity for the rapid spread of understory and grassland fires in many areas. After park designation, a succession of military and civilian stewards continued to suppress most fires with the intention of protecting the big trees from harm. Suppression efforts became dramatically more effective and extensive following the advent of helicopter use in the 1940's and 1950's with full suppression of all fires remaining the official policy through the mid-1960s. During the period of full suppression, fires became progressively more difficult, dangerous, and expensive to control due to the continued build-up of fire fuels across the landscape. During the 1960's research was systematically documenting the beneficial effects of fire on giant sequoia and other species, and recognizing fire as a keystone ecological process perpetuating Sierra Nevada ecosystems.

Since the 1960's it has been park policy to continue to suppress all human caused fires (except those intentionally set by park management) and many lightning ignited fires, while allowing some lightning ignitions to spread under carefully managed conditions.

Prescribed Burning

Concern about the impact of the parks' early fire suppression policy was first expressed for the middle elevation (4,000 to 7,000 feet) mixed conifer forest zone. The buildup of flammable ground fuels, the increase of white fir, the lack of giant sequoia reproduction, and the threat of wildfire to the sequoia groves all indicated the need to reintroduce fire into this zone by prescribed burning.

The prescribed burning program began in 1964 as an experimental research program to study the regeneration of sequoias. Drs. Richard Hartesveldt and Tom Harvey studied the regeneration of sequoias after several research areas were prescribed burned. They found that sequoia seed germination and seedling establishment is strongly related to disturbances of the substrate, the opening of the forest floor to light, and to the proximity of suitable substrate with trees of heavy cone loading (Hartesveldt and Harvey 1967). They also found that higher intensity fires produced even better conditions for seedling survival than light fires.

The experimental research program continued in 1968 when about 800 acres in a red fir forest were burned to study the ecological impact of prescribed fire on fir thickets (Kilgore 1971). Kilgore found that fire reduced the litter, duff, and humus by about 50% and killed many red fir seedlings and saplings. No adverse changes in deer, bird numbers, or water quality were observed.

Since the first experimental research burn in 1968 through 2013, an estimated 303 prescribed burns (68,479 acres) have occurred. For more information on the evolution of the prescribed fire management program see Bancroft et al. (1985).

Wildland Fire Management

Concurrent with the implementation of the prescribed fire program in 1968, the parks started managing some lightning fires to meet the parks' objectives for ecology and fuels reduction.. Natural lightning ignitions managed to restore or maintain ecological conditions and processes have been variously known as "*prescribed natural fires (PNFs)*", "*natural fires*", "*use of wildland fire* (generally shortened to just *fire use*)". Today these fires are considered unplanned events simply referred to as wildfire or fire managed for multiple objectives. While the names have changed over time to conform to standardized interagency terminology, the intent and practice of safely managing natural ignitions have remained constant in these parks. These fires in forested areas of the parks are generally slow burning, low intensity ground fires, which occasionally torch out individual trees, or make brief runs involving local crown fires. This type of fire is most common in higher elevations (> 8,000ft) due to the frequency of lightning strikes. In addition, the red fir, lodgepole pine, and subalpine forest communities found at high elevations are characterized by long-lived, widely spaced, and relatively short trees (Rundel et al. 1977). These forests are thought to have evolved with infrequent low intensity ground fires (Vankat 1970) due to the low temperatures and the short growing season. Because of the longer fire return intervals, these forest communities have not yet resulted in excessive fuel accumulations (Parsons 1977).

Due to the previous characteristics, most of the high elevation forests in the parks have been managed for multiple objectives, including a resource management emphasis over the last few decades. Since the beginning of the program, the parks have had 486 fires for a total of 42,460 acres. Most of these fires (89%) were less than 10 acres in size and only a few (6.5%) exceeded 100 acres in size. Fewer (2.1%) exceeded 1,000 acres in size. Most fire use projects have occurred in the red fir and subalpine vegetation types. The largest managed fire in the parks, the Ferguson Fire, burned an estimated 10,420 acres. It started on June 26, 1977, and burned for over four months. It was finally extinguished by snow in November of that year. The period of 1976 to 1977 was one of severe drought in California.

Managing Fire for Multiple Objectives

Since the Modifications to the Implementation of Federal Wildland Fire Management Policy (2008) the parks have pursued a strategy of holistically managing wildfire commensurate with the full range of factors likely to be affected by the fire. These factors include, but are not limited to:

- Location of the fire
- Time of the year
- Climatology and fuel moisture conditions
- Current and expected weather
- Impact to park visitors and other park operations
- Threats to fire sensitive cultural and natural resources
- Smoke impacts to the park and local communities
- Threat posed by the fire to the park boundary and private property
- Other local and national fire activity
- Availability of resources to successfully implement the course of action
- Probability of success in implementing the course of action

Each fire occurring in the parks is independently assessed to determine the best management options ranging from full suppression of monitoring along any or the entire fire perimeter. A full description of this methodology can be found in Chapter 3, Tool 2, Response to Wildland Fire of this plan.

11. References

Abell, D. L. 1977. A survey of macroscopic invertebrates of Sequoia streams. Unpubl. Report for Sequoia Natural History Association, Three Rivers, Calif. 84 pp.

Abell, D. L. 1984. Section VIII. Invertebrate studies. Pages 67-96 *in* a study to facilitate the Impacts of Kaweah No. 3 hydroelectric facility on the resources of Sequoia National Park.

Alexis, Andy, P. Gaffne, C. Garcia, M. Nystrom, and R. Rood. 1999. The 1999 California Almanac of Emissions and Air Quality. California Air Resources Board.

Anderson, R.S. and S.J. Smith. 1997. Sedimentary record of fire in montane meadows, Sierra Nevada, California, USA: a preliminary assessment. Pp 313-327. In. J.S. Clark, H. Cachier, J.G. Goldammer, and B. Stocks (eds). *Sediment Records of Biomass Burning and Global Change*. NATA ASI Series, Vol. 151, Springer-Verlag, Berlin.

Anderson, M.K. 2006. The use of fire by Native Americans in California. Chapter 17, pp. 417-430. In: Sugihara, N.G., J.W. Van Wagtendonk, K.E. Shaffer, J. Fites-Kaufman, A.E. Thode (eds.). 2006. Fire in California Ecosystems.Univ. Calif. Press, Berkeley, 596 pp.

Bancroft, W.L., H.T. Nichols, D.J. Parsons, D.G. Graber, Q.B. Evison, and J. van Wagtendonk. 1985. Evolution of the Natural Fire Program at Sequoia and Kings Canyon National Parks. pp. 174-180 In: J.E. Lotan, B.M. Kilgore, W.C. Fischer, and R.W. Mutch (tech. coord.) *Proceedings Symposium and Workshop on Wilderness Fire. 15-18 November 1983, Missoula, Montana.* USDA Forest Service General Technical Report INT-182. pp. 434

Barrett, S.W., T.W. Swetnam,and W.L. Baker. 2005. Indian fire use: Deflating the legend. Fire Management Today 65:31-33.

Beesley, D. 1996. Reconstructing the landscape: An environmental history, 1820-1960. pp. 3-24. In *Sierra Nevada Ecosystem Project: Final Report to Congress*, vol. II, chap. 37. Davis: University of California, Centers for Water and Wildland Resources.

Biswell, H.H. 1961. The Big Trees and Fire. National Parks Magazine 35:11-14.

Bond, W.J. and B.W. van Wilgen. 1996. *Fire and Plants*. Chapman and Hall, London. 263 pp

Bonnicksen, T.M. and E.C. Stone. 1978. An Analysis of Vegetation Management to Restore the Structure and Function Of Pre-settlement Giant Sequoia-Mixed Conifer Forest Mosaics. Headquarters Library, Sequoia-Kings Canyon National Parks.

Bradford, D. F., S. D. Cooper, T. M. Jenkins, Jr., K. Kratz, O. Sarnelle, and A. D. Brown. 1998. Influences of natural acidity and introduced fish on faunal assemblages in California alpine lakes. Can. J. Fish, Aquat. Sci. 55:2478-2491.

Brown, P.M., M.K. Hughes, C.H. Baisan, T.W. Swetnam, and A.C. Caprio. 1992. Giant sequoia ring-width chronologies from the central Sierra Nevada, California. Tree-Ring Bulletin 52:1-14.

Caprio, A.C. 2000 unpublished. Analysis done at Sequoia and Kings Canyon National Parks.

Caprio, A.C. 2000. Reconstructing attributes of pre-Euro American settlement fire at a watershed scale, Sequoia and Kings Canyon National Parks. Abstract and paper. 85th Ecol. Soc. Amer. Annual Meeting. p. 67.

Caprio, A.C. 2004. Temporal and spatial dynamics of pre-Euro American fire at a watershed scale, Sequoia and Kings Canyon National Parks. pp 107-125 In: *Proceedings of the Conference on Fire Management: Emerging Policies and New Paradigms. Nov. 16-19, 1999, San Diego, CA.*

Caprio, A.C. 2004. Temporal and spatial dynamics of pre-Euro American fire at a watershed scale, Sequoia and Kings Canyon National Parks. pp 107-125 In: *Proceedings of the Conference on Fire Management: Emerging Policies and New Paradigms. Nov. 16-19, 1999, San Diego, CA.*

Caprio, A.C. 2004a. LANDFIRE biophysical setting model 0610581 Sierra Nevada subalpine lodgepole pine forest and woodland-wet. <*http://www.landfire.gov*>. Accessed 27 February 2013.

Caprio, A.C. 2004b. LANDFIRE biophysical setting model 0610582 Sierra Nevada subalpine lodgepole pine forest and woodland-dry. <*http://www.landfire.gov*>. Accessed 27 February 2013.

Caprio, A.C. 2006. Fire history of lodgepole pine in the southern Sierra Nevada, California. In: *3rd International Fire Ecology and Management Congress Changing Fire Regimes: Context and Consequences*. Association of Fire Ecology, San Diego, Calif. 5 pp.

Caprio, A.C. 2008.Reconstructing Fire History of Lodgepole Pine on Chagoopa Plateau, Sequoia National Park, California1. pp. 255-262. In: Narog, Marcia G., technical coordinator. *Proceedings of the 2002 fire conference: managing fire and fuels in the remaining wildlands and open spaces of the Southwestern United States*. Gen. Tech. Rep. PSW-GTR-189. Albany, CA: USDA, Forest Service, Pacific Southwest Research Station. 363 p.

Caprio A.C., C. Conover, M. Keifer, and P. Lineback, 1997. Fire Management and GIS: a Framework for Identifying and Prioritizing Fire Planning Needs. In: *Proceedings of the Conference on Fire in California Ecosystems: Integrating Ecology, Prevention, and Management. Nov. 17-20, 1997, San Diego, CA.*

Caprio, A.C. and D.M. Graber. 2000. Returning Fire to the Mountains: Can We Successfully Restore the Ecological Role of Pre-Euro American Fire Regimes to the Sierra Nevada? In: Cole, David N.; McCool, Stephen F.; Borrie, William T.; O'Loughlin, Jennifer (comps). *Proceedings: Wilderness Science in a Time of Change-- Vol. 5 Wilderness Ecosystems, Threats, and Management; 1999 May 23-27; Missoula, MT.* Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Proceedings RMRS-P-15-VOL-5. pp 233-241.

Caprio, A.C. and P. Lineback 1997. Pre-Twentieth Century Fire History of Sequoia and Kings Canyon National Parks: A Review and Evaluation of Our Knowledge. In: *Proceedings of the Conference on Fire in California Ecosystems: Integrating Ecology, Prevention, and Management. Nov. 17-20, 1997, San Diego, CA.*

Caprio, A.C., and T.W. Swetnam. 1993. Fire history and fire climatology in the southern and central Sierra Nevada: Progress Report 1992/93 to National Park Service, Global Change Program, Southern and Central Sierra Nevada Biogeographical Area. Laboratory of Tree-Ring Research, University of Arizona, Tucson, AZ.. On file at Sequoia and Kings Canyon National Park. 14 pp.

Caprio, A.C., and T.W. Swetnam. 1994. Fire history and fire climatology in the southern and central Sierra Nevada: Progress Report 1993/94 to National Park Service, Global Change Program, Southern and Central Sierra Nevada Biogeographical Area. Laboratory of Tree-Ring Research, University of Arizona, Tucson, AZ. On file at Sequoia and Kings Canyon National Park. 16 pp.

Caprio, A.C., L.S. Mutch, T.W. Swetnam, and C.H. Baisan. 1994. Temporal and spatial patterns of giant sequoia radial growth response to a high severity fire in A.D. 1297. Final report to California Department of Forest and Fire Protection, Mtn. Home State For., Springville, CA. (Contract No. 8CA17025) by Lab. of Tree-Ring Research, Tucson, AZ, 61 pp.

Caprio, A. C., and T. W. Swetnam. 1995. Historic fire regimes along an elevational gradient on the west slope of the Sierra Nevada, California. pp.173–179. In: J. K. Brown, R. W. Mutch, C. W. Spoon, and R. H. Wakimoto. Proceedings*: Symposium on fire in wilderness and park management, technical coordination*. U.S. Forest Service, Intermountain Research Station. Ogden, UT. General Technical Report INT-GTR-320

Chang, C. 1996. Ecosystem responses to fire and variations in fire regimes. pp. 1071-1099. In: <u>Sierra Nevada Ecosystem Project: Final Report to Congress, Vol. II, Assessments and Scientific Basis for Management Options.</u> Wildlands Resources Center Report No.37, Centers for Water and Wildlands Resources, University of California, Davis, California, USA. 1528 pp.

Christensen, Norman L., L. Cotton, T. Harvey, R. Martin, J. McBride, Pl Rundel, R. Wakimoto. 1987. Review of Fire Management Program for Sequoia Mixed Conifer Forests of Yosemite, Sequoia, and Kings Canyon National Parks. NPS Management Report.

Collins, B.M., M. Kelly, J.W. von Wagtendonk, S.L. Stephens. 2007. Spatial patterns of large natural fires in Sierra Nevada wilderness areas. *Landscape Ecology*. 2007 22(4). p.545

Collins B.M. and S.L. Stephens. 2007. Managing natural wildfires in Sierra Nevada wilderness areas. *Front Ecol Environ* 5:523–7.

Cook, E. R., C.A. Woodhouse, C.M. Eakin, D.M. Meko, and D.W. Stahle. 2004. Long-term aridity changes in the western United States. *Science* 306:1015–1018.

Cook, E.R., R. Seager, M.A. Cane, and D.W. Stahle. 2007. North American drought: Reconstructions, causes, and consequences. *Earth-Sci Rev* 81:93–134.

Cooper, C.F. 1960. Changes in Vegetation, Structure, and Growth of Southwestern Pine Forest Since White Settlement. *Ecological Monographs* 30:129:164.

Davis, O. K., and M. J. Moratto. 1988. Evidence for a warm dry early Holocene in the western Sierra Nevada of California: Pollen and plant macrofossil analysis of Dinkey and Exchequer Meadows. Madroño 35:132–49.

Dawson, K. 1987. *Special Management Area Visual Resources Management Study for the Sequoia National Park Prescribed Fire Management Program*. Prepared by Center for Design Research, Department of Environmental Design, University of California, Davis for the U.S. Department of the Interior, Sequoia & Kings Canyon National Parks.

Dilsaver, L.M. and W.C. Tweed. 1990. *Challenge of the Big Trees: A Resource History of Sequoia and Kings Canyon National Parks.* Sequoia Natural History Society, Three Rivers, CA. 379 pp.

Ferrenberg, S.M., D.W. Schwilk, E.E. Knapp, E. Groth and J.E. Keeley. 2006. Fire decreases arthropod abundance but increases diversity: early and late season prescribed fire effects in a Sierra Nevada mixed-conifer forest. *Fire Ecology* 2:79-102.

Gill, A.M. 1975. Fire and the Australian flora: a review. Australian Forestry 38:4-25.

Hann, W.J. and D.L. Bunnell 2001. *Fire and land management planning and implementation across multiple scales*. International Journal of Wildland Fire. 10(3&4): 389–403.

Hartesveldt, R.J. and H.T. Harvey. 1967. The Fire Ecology of Sequoia Regeneration. Tall Timbers Fire Ecology Conference Proceedings. 7:65-77.

Harvey, H.T., H.S. Shellhammer, and R.E. Stecker. 1980. Giant Sequoia Ecology: Fire and Reproduction. Scientific Monograph Series, No. 12. USDI NPS, Washington, DC. 182 pp.

Heinselman, M.L. 1981. Fire intensity and frequency as factors in the distribution and structure of northern ecosystems. pp. 7-57. In: H.A. Mooney , T.M. Bonnicksen, N.L. Christensen, J.E. Lotan, and W.A. Reiners (tech. coord.). *Proceedings of the Conference: Fire Regimes and Ecosystem Properties. Dec. 11-15, 1978, Honolulu, Hawaii*. USDA Forest Service, GTR-WO-26, 594 pp.

Huntington, G.L. and M.A. Akeson. 1987. Soil resource inventory of Sequoia National Park, Central Part, California; Pedologic investigations in support of acid rain studies, Sequoia National Park, California. Univ. of Calif. Davis, Dept of Land, Air, and Water Resources 263p.

Kauper, D., Stephenson, N., and Warner, T. 1980. *The Effect of Past Management Actions on the Composition and structure of Vegetation in the Grant Tree Portion of Grant Grove*. Prepared by the Resources and Management Division of Sequoia and Kings Canyon National Parks, Three Rivers, California.

Keeley, J.E., M. Baer-Keeley, and C.J. Fotheringham. 2005a. Alien plant dynamics following fire in mediterranean-climate California shrublands. *Ecological Applications*, 15:2109–2125.

Keeley, J.E., A.H. Pfaff, and H.D. Safford. 2005b. Effectiveness and longevity of fuel treatments in coniferous forests across California. International. *J. Wildland Fire* 14:255-265.

Keifer, M. 1991. Age structure and fire disturbance in southern Sierra Nevada subalpine forests. MS Thesis, Univ. of Arizona, 111 pp.

Keifer, M., J.W. van Wagtendonk, and M. Buhler. 2006. Long-term surface fuel accumulation in burned and unburned mixed-conifer forests of the central and southern Sierra Nevada, CA (USA). *Fire Ecol.* 2(1): 53-72.

Kilgore, B.M. 1971. The Role of Fire in Managing Red Fir Forests. Transcript North American Wildlife Natural Research Conference. 36:405-416.

Kilgore, B.M. 1972. Fire's Role in a Sequoia Forest. Naturalist 23(1):26-37.

Kilgore, B.M. 1973. The ecological role of fire in Sierran conifer forests: Its application to national park management. Quaternary Research 3:496–513.

Kilgore, B.M. and D. Taylor. 1979. Fire history of a sequoia mixed-conifer forest. Ecology 60:129-142.

Kilgore, B.M. and G.S. Briggs. 1972. Restoring Fire to High Elevation Forests in California. J. Forestry 70:266-271.

Kilgore, B.M. and R.W. Sando. 1975. Crown-fire Potential in a Sequoia Forest after Prescribed Burning. Forest Science 21:83-87.

Kinney, W.C. 1996. Conditions of rangelands before 1905. pp. 31-45. In *Sierra Nevada Ecosystem Project: Final Report to Congress*, vol. II, chap. 37. Davis: University of California, Centers for Water and Wildland Resources.

Knapp, E.E., and J.E. Keeley. 2006. Heterogeneity in fire severity within early season and late season prescribed burns in a mixed-conifer forest. *Internet J. Wildland Fire* 15:37-45.

Knapp, E.E., J.E. Keeley, E.A. Ballenger, and T.J. Brennan. 2005. Fuel reduction and coarse woody debris dynamics with early season and late season prescribed fire in a Sierra Nevada mixed conifer forest. *Forest Ecology and Management* 208:383-397

Knapp, R. A., K. R. Matthews, and O. Sarnelle. 2001. Resistance and resilience of alpine lake fauna to fish introductions. Ecological Monographs 71:401-421.

Knapp,E.E., D.W. Schwilk, J.M. Kane, and J.E. Keeley. 2007. Role of burning season on initial understory vegetation response to prescribed fire in a mixed conifer forest. *Can. J. For. Res.* 37:11-22.

Kratz, K. W., S. D. Cooper, and J. M. Melack. 1994. Effects of single and repeated experimental acid pulses on invertebrates in a high altitude Sierra Nevada stream. Freshwater Biology 32:161-183.

Kubly, D. M. 1983. Plankton of high Sierra lakes. Southern California Edison Research and Development Report No. 830RD-47. Univ. California, Riverside. 96 pp.

Lewis, H. T. 1973. Patterns of Indian burning in California: Ecology and ethnohistory. Ballena Press Anthropological Papers No. 1, Ramona, CA, 101 pp.

Lyle, J. 2002. Standard Operating Procedures for Distributing Fire Information, Sequoia and Kings Canyon National Parks.

McBride, J.R. and D.F. Jacobs. 1980. Land use and fire history in the mountains of southern California. pp. 85-88. In: M.A. Stokes and J.H. Dieterich (tech. coord.). *Proceedings of the Fire History Workshop. October 20-24, 1980, Tucson, Arizona*. USDA Forest Service, GTR-RM

McClaren, M.P. and J.W. Bartolome. 1989. Fire-related recruitment in stagnant *Quercus douglasii* populations. Canadian Journal of Forest Research 19:580-585.

McKelvey, K. S., C. N. Skinner, C. Chang, D. C. Erman, S. J Husari, D. J. Parson, J. W. van Wagtendonk, C. P. Weatherspoon. 1996. An overview of fire in the Sierra Nevada. In *Sierra Nevada Ecosystem Project: Final Report to Congress*, vol. II, chap. 37. Davis: University of California, Centers for Water and Wildland Resources.

Mensing, S.A. 1992. The impact of European settlement on blue oak (*Quercus douglasii*) regeneration and recruitment in the Tehachapi Mountains, California. Madroño 39:36-46.

Muir, J. (edited by L. M. Wolfe). 1938. *John of the Mountains.*

Muir, J. 1877. On the post-glacial history of *Sequoia gigantea*. Proceedings American Association Advanced Sciences, Volume 25.

Mutch, L.S., M.G. Rose, A.M. Heard, R.R. Cook, and G.L. Entsminger. 2008. Sierra Nevada Network Vital Signs Monitoring Plan: Appendices A-H. *Natural Resources Report NPS/SIEN/NRR-2008/072*. 354 pp.

National Park Service, U.S. Department of the Interior. 2014. Reference Manual #18 – Wildland Fire Management
http://www.nps.gov/fire/wildland-fire/about/policy.cfm

National Park Service, U.S. Department of Interior. 2010. Director's Order #58 – Structural Fire Management.
http://www.nps.gov/fire/structural-fire/about/policy.cfm

National Park Service. 2003. Fire Monitoring Handbook. Boise (ID): Fire Management Program Center, National Interagency Fire Center. 274p.

http://www.nps.gov/fire/wildland-fire/what-we-do/science-ecology-and-research.cfm

National Park Service, U.S. Department of Interior. 2013. Reference Manual #60 – Aviation Management.

http://www.nps.gov/fire/aviation/about/policy.cfm

National Park Service. 1995. Guidelines for Ecological Restoration, Giant Forest, Sequoia and Kings Canyon National Parks, Appendix B. Interim Management Plan/Environmental Assessment Giant Forest, Sequoia National Park, California.

National Wildfire Coordinating Group. 2014. Wildland Fire Incident Management Field Guide – Publication 210.
http://www.nwcg.gov/pms/pubs/pms210/index.htm

National Wildfire Coordinating Group. 2013. Wildland and Prescribed Fire Qualification System Guide – Publication 310-1.http://www.nwcg.gov/pms/docs/docs.htm

North, M., J. Innes, and H. Zald. 2007. Comparison of thinning and prescribed fire restoration treatments to Sierran mixed-conifer historic conditions. *Canadian Journal of Forest Research* 37: 331-342.

Parsons, D. J. 1981. The historical role of fire in the foothill communities of Sequoia National Park. Madrono 28(3):111-120.

Parsons, D. J. and S. H. DeBenedetti. 1979. Impact of fire suppression on a mixed-conifer forest. Forest Ecology and Manage. 2:21-31.

Parsons, D.J. 1977. Preservation in Fire-Type Ecosystems. pp. 172-182. In: H.A. Mooney and C.E. Conrad (tech. Coord.) *Proceedings of the Symposium on the Environmental Consequences of Fire and Fuel management in Mediterranean Ecosystems.* USDA Forest Service GTR-WO-3. 498 pp.

Pitcher, D. 1981. The ecological effects of fire on stand structure and fuel dynamics in red fire forests of Mineral King, Sequoia National Park, California. MS Thesis, UC Berkeley, 168 pp.

Pitcher, D. 1987. Fire History and Age Structure in Red Fir Forests of Sequoia National Park, California. Canadian Journal of Forest Research 17:582-587.

Quinn, Joyce A. 1987. Visitor Perception of NPS Fire Management in Sequoia and Kings Canyon National Parks: Results of a Survey Conducted Summer 1987. Technical Report #36.

Reynolds, R. D. 1959. Effect of natural fires and aboriginal burning upon the forests of the central Sierra Nevada. Master's thesis, University of California, Berkeley.

Roberts, P. T., T. B. Smith, C. G. Lindsey 1991. Analysis of San Joaquin Valley Air Quality and Meteorology, in Proceedings of the 84th.

Rundel, P.W., D.J. Parsons, and D.T. Gordon. 1977 (1988). Montane and subalpine vegetation of the Sierra Nevada and Cascade Ranges. pp 559-599. In: M.G. Barbour and J. Major (eds.). Terrestrial Vegetation of California. California Native Plant Society. Special Publication Number 9. 1030 pp.

Schissler, P. 1999. Fire Management Planning for Sequoia and Kings Canyon National Parks: A Public Opinion Survey of the Residents of Three Rivers, California. Management Report, Paul Schissler Associates, Incorporated, Bellingham, Washington. 64 pp.

Scholl, A.E. and A.H. Taylor. 2010. Fire regimes, forest changes, and self-organization in an old-growth mixed conifer forest, Yosemite National Park, USA. *Ecological Applications* 20:362-380.

Schwilk, D.W., and A.C. Caprio. 2011. Scaling from leaf traits to fire behaviour: community composition predicts fire severity in a temperate forest. *J. Ecol*. 99:970-980

Schwilk, D.W., E.E. Knapp, S.M. Ferrenberg, J.E. Keeley, A.C. Caprio. 2006. Tree mortality from fire and bark beetles following early and late season prescribed fires in a Sierra Nevada mixed-conifer forest. *Forest Ecology and Management* 232:36-45.

Scott, J.H. and R.E. Burgan. 2005. Standard fire behavior fuel models: a comprehensive set for use with Rothermel's surface fire spread model. USDA FS Rocky Mtn. Res. Sta., Gen. Tech. Rep. RMRS-GTR-153, 80 pp.

Sheppard, P.R. 1984. Fire regime of the lodgepole pine (*Pinus contorta* var. *murrayana*) forests of the Mt. San Jacinto State Park wilderness, California. MS Thesis, Cornell University, NY. 93 pp.

Show, S.B., and E.I. Kotok. 1924. *The Role of Fire in the California Pine Forests*. U.S. Printing Off., Washington, D.C.

Skinner, C.N. and C. Chang. 1996. Fire regimes, past and present. pp. 1041-1069. In: Sierra Nevada Ecosystem Project, Final Report to Congress: Status of the Sierra Nevada, Vol. II, Assessments and Scientific Basis for Management Options. 1528 pp.

Smith, S. J., and R. S. Anderson. 1992. Late Wisconsin paleoecologic record from Swamp Lake, Yosemite National Park, California. Quaternary Research 38:91–102.

SNEP. 1996. Sierra Nevada Ecosystem Project, Final Report to Congress: Status of the Sierra Nevada.

Stephens, S.L. 1997. Fire history of a mixed conifer oak-pine forest in the foothills of the Sierra Nevada, El Dorado County, California. pp 191-198. In: N.H. Pillsbury, J. Verner, and W.D. Tietje (tech. coord.). *Proceedings of a Symposium on Oak Woodlands: Ecology, Management, and Urban Interface Issues. 19-22 March 1996. San Luis Obispo, CA.* Gen. Tech. Rep. PSW-GTR-160, 738 pp.

Stephenson, N.S. 1996. Ecology and management of giant sequoia groves. pp. 1431-1467. In: Sierra Nevada Ecosystem Project, Final Report to Congress: Status of the Sierra Nevada, Vol. II, Assessments and Scientific Basis for Management Options. 1528 pp.

Stephenson, N.S. 1999. Reference conditions for giant sequoia forest restoration: structure, process, and precision. Ecol. Appl. 9:1253-1265.

Stephenson, N.S., D.J. Parsons, and T.W. Swetnam. 1991. Natural Fire to the Sequoia-Mixed Conifer Forest: Should Intense Fire Play a Role. pp.321-337. In: *Proc. 17th Tall Timbers Fire Ecology Conference, May 18-21, 1989: High Intensity Fire in Wildlands: Management Challenges and Options.* Tall Timbers Research Station, Tallahassee, Florida. 435 pp.

Stoddard, J. L. 1987. Microcrustacean communities of high elevation lakes in the Sierra Nevada, California. J. Plank. Res. 9:631-650.

Storie, R. E. 1953. Revision of soil rating chart. California Agric. Exp. Stn. 4 pp., illus.

Sugihara, N.G., J.W. Van Wagtendonk, K.E. Shaffer, J. Fites-Kaufman, A.E. Thode (eds.). 2006. Fire in California Ecosystems.Univ. Calif. Press, Berkeley, 596 pp.

Swetnam, T.W. 1993. Fire History and Climate Change in Giant Sequoia Groves. Science 262:885-889.

Swetnam, T.W., C.H. Baisan, A.C. Caprio, R. Touchan, and P.M. Brown. 1992. Tree-ring reconstruction of giant sequoia fire regimes. Final report to Sequoia, Kings Canyon and Yosemite National Parks, Laboratory of Tree-Ring Research, Tucson, AZ. 90 pp. + appendices.

Swetnam, T.W., C.H. Baisan, A.C. Caprio, P.M. Brown, R. Touchan, R.S. Anderson, and D.J. Hallett. 2009. Multi-millennial fire history of the Giant Forest, Sequoia National Park, California, USA. *Fire Ecology* 5:120-150.

Swetnam, T.W., C.H. Baisan, K. Morino, and A.C. Caprio. 1998. Fire History Along Elevational Transects in the Sierra Nevada, California. Final Report to Sierra Nevada Global Change Research Program, USGS BRD Sequoia and Kings Canyon, and Yosemite Field Stations. On file at Sequoia and Kings Canyon National Parks. 65 pp.

Swetnam, T.W., R. Touchan, C.H. Baisan, A.C. Caprio, and P.M. Brown. 1991. Giant sequoia fire history in Mariposa Grove, Yosemite National Park. In: *Yosemite Centennial Symposium, Proceedings: Natural Areas and Yosemite: Prospects for the Future, Oct. 13-20, 1990*, Concord, Calif. NPS D-374.

Taylor, T. P. and D. C. Erman. 1980. The littoral bottom fauna of high elevation lakes in Kings Canyon National Park. California Department of Fish and Game 66:112-119.

Taylor. A.H. and R.M. Beaty. 2005. Climatic Influences on Fire Regimes in the Northern Sierra Nevada Mountains, Lake Tahoe Basin, Nevada, USA. *J. Biogeography* 32:425-438

Vale, T.R. 1998. The myth of the humanized landscape: an example from Yosemite National Park. Natural Areas Journal 18:231-236.

Vale, T.R. (eds). 2002. Fire, Native Peoples and the Natural Landscape. Island Press, Washington, 315 pp.

Van Wagtendonk, J.W. 1972. Fire and Fuel Relationships for Yosemite National Park. USDI, NPS Occa. Paper No.2. 21 pp.

Van de Water, K. and M. North. 2011. Stand structure, fuel loads, and fire behavior in riparian and upland forests, Sierra Nevada Mountains, USA; a comparison of current and reconstructed conditions. *For. Ecol. & Management* 262:215-228.

Vankat 1977. Fire and Man in Sequoia National Park. Annuals of the Association of American Geographers. 67(1): 17-27

Vankat, J. L. 1985. General patterns of lightning ignitions in Sequoia National Park, California. In: J. E. Lotan, B. M. Kilgore, W. C. Fischer, and R. W. Mutch, (tech. coord.). *Proceedings of the symposium and workshop on wilderness fire*, 408–11. General Technical Report INT-182. Ogden, UT: U.S. Forest Service, Intermountain Research Station.

Vankat, J.L. 1970. Vegetation change in Sequoia National Park, California. Ph.D. Thesis, University of California, Davis, CA. 197 pp.

Warner, T.E. 1980. Fire History in the Yellow Pine Forest of Kings Canyon National Park. pp. 89-92. In: M.A. Stokes and J.H. Dieterich (tech. coord.). *Proceedings of the Fire History Workshop. October 20-24, 1980, Tucson, Arizona*. USDA Forest Service, GTR-RM-81

Weaver, H. 1967. Fire and its Relationship to Ponderosa Pine. Proc. Tall Timbers Fire Ecology Conference. 7:127-149.

Weaver, H. 1974. Effects of Fire on Temperate Forests: Western United States. In: *Fire and Ecosystems*. T.T. Kozlowski and C.E. Ahlgren, eds. Academic Press. 542 pp.

Westerling, A.L., H.G. H.G. Hidalgo, D.R. Cayan, and T.W. Swetnam. 2006. Warming and earlier spring increases western U.S. forest fire activity. *Science* 313:940-943.

Whelan, R.J. 1995, *The Ecology of Fire*. Cambridge Univ. Press, Cambridge, 346 pp

Appendix

A - Five-Year Fuels Treatment Plan

Table A-1: Five-Year Fuels Treatment Plan

Five-Year Fuels Treatment Plan Fiscal Year	FMU	Project Name	Target Acres	Notes
FY14	Cedar Grove	Valley Floor	45	This is a maintenance burn building off of previously burned units within the Cedar Grove FMU.
	East Fork	Lookout	4	This is a mechanical thinning project in the Mineral King fee station area of the East Fork FMU.
	Grant Grove	Goliath	769	This restoration burn builds off of previously burned units in the Redwood Canyon area within the Grant Grove FMU.
	Grant Grove	Grant Grove Mechanical	25	This is a mechanical thinning project in the Grant Grove/Wilsonia developed area of the Grant Grove FMU.
	Grant Grove	Swale West	191	This is a maintenance burn within the Grant Grove FMU. It was last burned in 1995.
	Marble Fork	Bear Hill	163	This is a Giant Forest maintenance burn within the Marble Fork FMU. This was last burned in 2001.
	Middle Fork	Ash Mountain	23	These are annual maintenance burns conducted around the Ash Mountain Headquarter complex within the Middle Fork FMU.
	Middle Fork	Hospital Rock	2	This is part of the annual maintenance burns conducted around the Ash Mountain Headquarter complex within the Middle Fork FMU.
FY15	Cedar Grove	Bubbs	261	This is a maintenance burn building off of previously burned units within the Cedar Grove FMU.
	Cedar Grove	Lewis Camp	78	This is a maintenance burn building off of previously burned units within the Cedar Grove FMU.
	East Fork	Mosquito	1484	This is a restoration burn within the East Fork FMU south of Silver City and Mineral King.
	Grant Grove	North Boundary	242	This is a restoration burn building off previously burned units within the Grant Grove FMU.
	Grant Grove	Sequoia Creek	262	This is a maintenance burn within the Grant Grove FMU. It incorporates the 1995 Wye burn and the 2002 Sunset D burn.
	Marble Fork	Halstead A	685	This is a maintenance burn below the Wuksachi area within the Marble Fork FMU. This was last burned in 1980.
	Marble Fork	Sunset Rock	62	This is a Giant Forest maintenance burn within the Marble Fork FMU. This was last burned in 2002.
	Middle Fork	Ash Mountain/Hospital Rock	25	These are annual maintenance burns conducted around the Ash Mountain Headquarter complex within the Middle Fork FMU.
	North Fork	Dorst	195	This restoration burn builds off the 2006 Cabin Meadow and burn unit to protect the Dorst campground within the North Fork FMU.
FY16	Cedar Grove	Horse Trail	102	This is a maintenance burn building off of previously burned units within the Cedar Grove FMU. This was last burned in 2006.
	Cedar Grove	Roads End	128	This is a maintenance burn building off of previously burned units within the Cedar Grove FMU. This was last burned in 2005.
	East Fork	Deadwood	265	This maintenance burn builds off the Davenport and Atwell thinning units within the East Fork FMU. This was last burned in 1999.
	Grant Grove	Pan Point	368	This is restoration burn is a joint project with the USFS within the Grant Grove FMU.
	Grant Grove	Tower	240	This is a restoration burn building off previously burned units within the Grant Grove FMU.
	Marble Fork	Halstead B	970	This maintenance burn builds off the Halstead A unit within

				the Marble Fork FMU. This was last burned in 1980.
	Middle Fork	Ash Mountain/Hospital Rock	25	These are annual maintenance burns conducted around the Ash Mountain Headquarter complex within the Middle Fork FMU.
	North Fork	Lost Grove	618	This restoration burn builds off the 2006 Cabin Meadow unit to protect the Dorst campground within the North Fork FMU.
	South Fork	Dillonwood Hand Pile	12	This is part of the above mentioned Dillonwood thinning project.
	South Fork	Dillonwood Thinning	12	This is a mechanical thinning project in the Dillonwood developed area of the South Fork FMU.
FY17	Cedar Grove	Zumwalt	190	This is a maintenance burn building off of previously burned units within the Cedar Grove FMU. This was last burned in 2008.
	Grant Grove	Partin	320	This restoration burn builds off of previously burned units in the Redwood Canyon area within the Grant Grove FMU.
	East Fork	Deer Creek	941	This maintenance burn builds off the Mosquito unit within the East Fork FMU. This last burned in 1991.
	Marble Fork	Highway	133	This is a Giant Forest maintenance burn within the Marble Fork FMU. This was last burned in 2002.
	Marble Fork	Sherman Creek A & B	360	These are Giant Forest maintenance burns within the Marble Fork FMU. These were last burned in 2001 and 2002.
	Middle Fork	Ash Mountain/Hospital Rock	25	These are annual maintenance burns conducted around the Ash Mountain Headquarter complex within the Middle Fork FMU.
	North Fork	Cave	271	This restoration burn builds off the 2008 Hidden Fire to treat fuels along the Crystal Cave Road within the North Fork FMU.
	North Fork	Water Tank	155	This restoration burn builds off previously burned units around Dorst campground within the North Fork FMU.
	Park Wide	Park Wide Pile Burning	8	This is all the pile burning in both the Sequoia and Kings Canyon Districts.
	South Fork	Dillonwood	1941 (est)	This is an interagency restoration burn around the Dillonwood area of the South Fork FMU.
FY18	Cedar Grove	Falls	150	This is a maintenace burn within the Cedar Grove FMU. This was last burned in 2009.
	East Fork	Atwell	2714	This is a maintenance burn building off previously burned units within the East Fork FMU.
	Grant Grove	Big Baldy	1604	This is a restoration burn building off of previously burned units in the Redwood Canyon area within the Grant Grove FMU.
	Grant Grove	Big Stump East (burning)	116 (est)	This is a restoration burn within the Grant Grove FMU east of the Big Stump entrance station. There may be significant cultural resources present in this unit.
	Grant Grove	Big Stump East Hand Pile	32 (est)	This is part of the above mentioned Big Stump East thinning project.
	Grant Grove	Big Stump East Thinning	32 (est)	This is a mechanical thinning project east of the Grant Grove entrance station. There may be significant cultural resources present in this unit.
	Grant Grove	Big Stump West (burning)	70 (est)	This is a restoration burn within the Grant Grove FMU west of the entrance station. There may be significant cultural resources in this unit.
	Grant Grove	Big Stump West Hand Pile	142 (est)	This is part of the above mentioned Big Stump West thinning project.
	Grant Grove	Big Stump West Thinning	142 (est)	This is a mechanical thinning project west of the Big Stump entrance station within the Grant Grove FMU. There may be significant cultural resources present in this unit.
	Marble Fork	Beetle Rock	326	This restoration burn builds off the 2008 Beetle Rock thinning project and provides protection to the surrounding infrastructure within the Marble Fork FMU.
	Marble Fork	Long Meadow	605	This restoration burn builds off the Quarry unit within the Marble Fork FMU.
	Marble Fork	Suwanee Grove	1883	This maintenance burn builds off the Halstead A & B units within the Marble Fork FMU. This was last burned in 1992.
	Middle Fork	Ash Mountain/Hospital Rock	25	These are annual maintenance burns conducted around the Ash Mountain Headquarter complex within the Middle Fork FMU.

	North Fork	West Dorst	244	This restoration burn builds off previously burned units around Dorst campground within the North Fork FMU.
FY19	Cedar Grove	Hole-in-the-Wall	36	This is a maintenance burn building off of previously burned units within the Cedar Grove FMU.
	Cedar Grove	Viewpoint	67	This is a maintenance burn building off of previously burned units within the Cedar Grove FMU.
	East Fork	Lookout	1455	This is a maintenance burn within the East Fork FMU. This was last burned in 1998.
	Grant Grove	Buena Vista	132	This is a maintenance burn in the Redwood Mountain area of the Grant Grove FMU.
	Grant Grove	General Grant North	131	This is a maintenance burn within the Grant Grove FMU.
	Grant Grove	Quail Flat	110	This is a maintenance burn in the Redwood Mountain area of the Grant Grove FMU.
	Marble Fork	Hazelwood	277	This is a Giant Forest maintenance burn within the Marble Fork FMU. Perimeter is the 2003 Giant wildfire.
	Marble Fork	Tharps	218	This is a Giant Forest maintenance burn within the Marble Fork FMU.
	Marble Fork	Upper Halstead	880	This maintenance burn builds off the Wukaski unit within the Marble Fork FMU. This was last burned in 1999.
	Middle Fork	Ash Mountain/Hospital Rock	25	These are annual maintenance burns conducted around the Ash Mountain Headquarter complex within the Middle Fork FMU.
	North Fork	Pine Ridge	627	This restoration burn builds off the 2008 Hidden wildfire within the North Fork Kaweah FMU.
	Park Wide	Park Wide Pile Burning	174	This is all the pile burning in both the Sequoia and Kings Canyon Districts.

B - NEPA and NHPA Compliance

Following National Environmental Policy Act (NEPA) guidelines and NPS policy, a companion environmental assessment evaluates the effects of proposed fire and fuels management actions on the environment. The *Environmental Assessment* and this associated plan were submitted for public review on April 16, 2003, with the comment period ending May 30, 2003.

The following text briefly describes the actions taken develop the plan and evaluate effects.

INTERNAL AND PUBLIC SCOPING

A Scoping Notice was placed in the Federal Register on February 24, 1999 and press releases regarding the planning effort were sent to media outlets in the region at the outset of the planning process. Two internal scoping meetings were held for all park and concession employees, and five additional public scoping sessions were conducted throughout California. Several presentations were made to special interest groups at their request to solicit comments. These groups included the Mineral King Cabin Owners Association and Friends of the South Fork Kings River. A community-wide survey was conducted in the greater Three Rivers area to further assess issues of concern.

INTERAGENCY SCOPING

Adjacent land managers were consulted both through the public notification process and through a separate scoping session held in Fresno in May 1999. The U.S. Fish and Wildlife Service (USFWS) was contacted at the onset of the planning process to ensure proper Section 7 consultation. A list of species to consider was received from the USFWS and used to prepare this document. Prior consultation with USFWS on the effects of prescribed burns on the threatened valley elderberry longhorn beetle is incorporated in this plan (correspondence attached at end of this chapter). The San Joaquin Valley Unified Air Pollution Control District received a separate scoping presentation and a formal written request for comment was sent to the District. No comments were received from the District during the scoping process.

CULTURAL RESOURCES AND NATIVE AMERICAN CONSULTATION

The National Park Service conducted consultation meetings in July of 1999 with a variety of Native American (American Indian) tribal groups and individuals. These meetings were held on both sides of the Sierra Nevada in areas from which Native American groups historically accessed and used lands now subsumed by Sequoia and Kings Canyon National Parks. Information was received from eight separate groups regarding their past and present uses of the parks, with a total of 33 individuals being interviewed. In very general terms, the eastside meetings included Paiute and Eastern Mono groups of the Owens Valley while the westside meetings focused on Yokuts and Western Mono (Monache) groups that traditionally occupied portions of the Great Central Valley and western foothills and slopes of the Sierran range (Van Horn and Burge).

Overall, those groups that shared concerns or comments regarding the parks' fire program were interested in continuing to receive information and in being consulted regarding the planning and implementation of prescribed fires, in particular. A clear interest in recognizing the effects of fire on any number of natural resources was expressed, as these resources hold ongoing importance to tribal members.

INTERDISCIPLINARY PLANNING TEAM MEMBERS (FROM 2003)

Sequoia & Kings Canyon National Parks

Jeffrey Manley
Natural Resources Management Specialist
(Now retired)

William Kaage
Fire Management Officer
(Now working at NIFC)

Jody Lyle
Fire Information and Education Specialist
(Now working at WASO)

MaryBeth Keifer
Ecologist
(Now working at NIFC)

Scott Williams
Prescribed Fire Technician
(Now employed by the USFS)

Corky Conover
Fuels Specialist
(Now working at PWR)

Tom Burge
Archeologist
(Now retired)

Anthony C. Caprio
Fire Ecologist

Additional Consultants & Preparers

Dr. Nathan Stephenson
Research Scientist
USGS Biological Resources Division
Sequoia & Kings Canyon Field Station

David Allen
Sequoia District Fire Management Officer
Sequoia & Kings Canyon National Parks

Sylvia Haultain
Plant Ecologist
Sequoia & Kings Canyon National Parks

Harold Werner
Wildlife Biologist
Sequoia & Kings Canyon National Parks
(Now retired)

Annie Esperanza
Air Quality Specialist
Sequoia & Kings Canyon National Parks

John Austin
Environmental Compliance Specialist/Resource Planner
Sequoia & Kings Canyon National Parks

Alan Schmierer
Environmental Compliance Specialist
NPS Pacific West Regional Office
(Now working at PWR)

Richard Smedley
Regional Fire Planner
NPS Pacific West Regional Office
(Now retired)

Nelson Siefkin
Regional Fire Archeologist
NPS Pacific West Regional Office

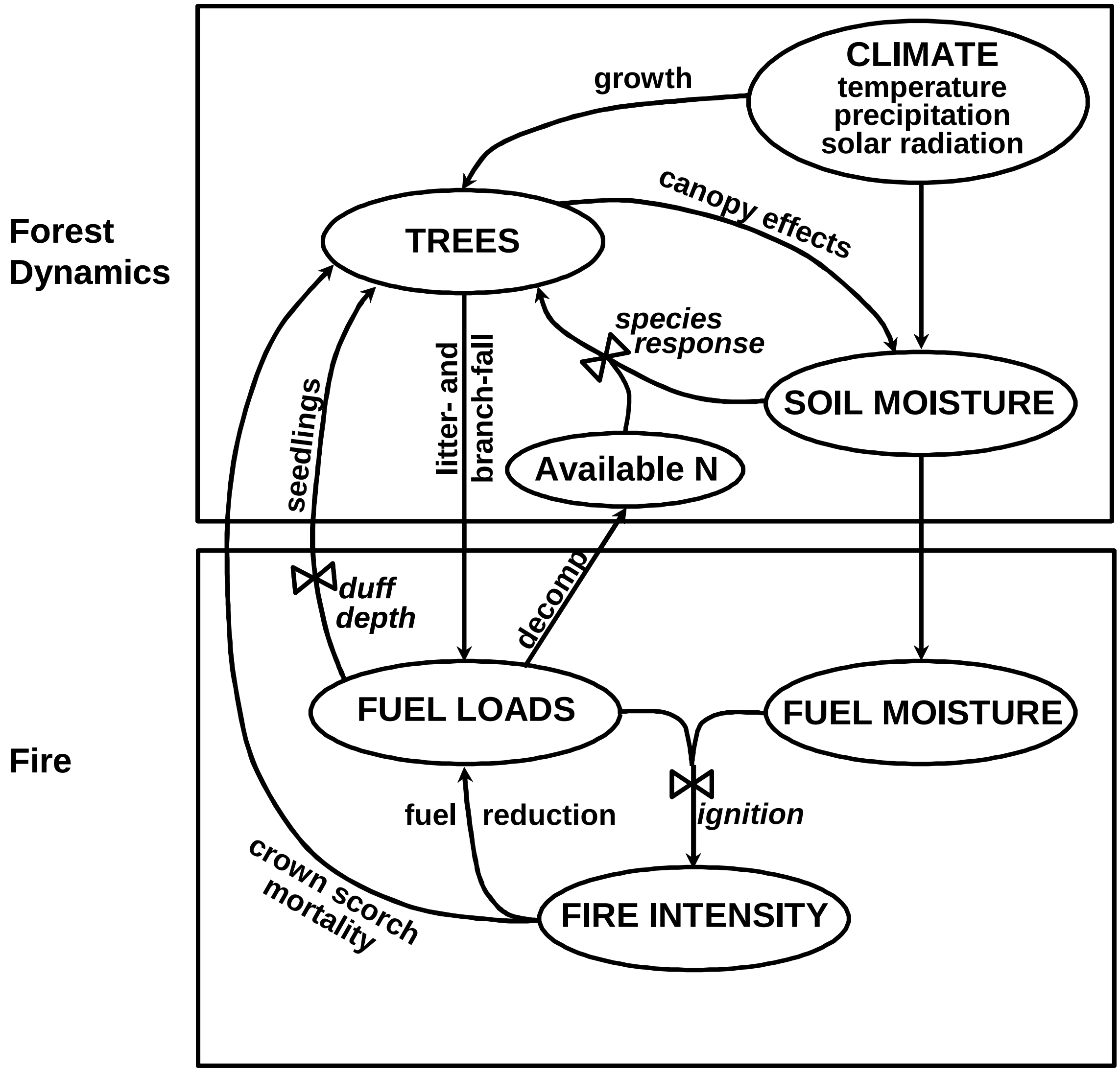
C - Fire Monitoring Plan and Target Conditions

INTRODUCTION

The purpose of the fire monitoring program is to provide effective evaluation of Sequoia and Kings Canyon National Parks' fire management program. The fire monitoring program is designed to determine whether fire and resource management objectives are met, as well as to document any unexpected consequences of fire management activities. The monitoring program continuously informs the staff about results of management activities so that the fire management program can adapt to changing conditions using the best available information. This plan will be reviewed annually and revised as needed.

To determine an efficient monitoring strategy to assess fire management program effectiveness, a basic understanding of the ecosystem components, processes, and linkages is needed. Based upon early fire research results, much of the current fire monitoring program for Sequoia and Kings Canyon National Parks was established prior to development of a formalized ecosystem model. Since then, a general ecosystem model was developed for the parks' Resource Management Plan (NPS 1999). Also, see the Description of NPS Unit (Chapter 8) and the Historic Role of Fire (Chapter 9) for information describing the fire-related components and processes occurring in Sequoia and Kings Canyon National Parks' ecosystems. Figure 1 illustrates the fire, fuel, and stand dynamics relationships that shape forests in the parks. Portions of the fire monitoring program focus on several of the important resource components in this model. A more detailed ecosystem model was developed as part of the NPS Inventory and Monitoring Program (Mutch et al 2008).

Figure C-1:-General model showing the relationships of fire fuel and forest dynamics in the southern Sierra Nevada (Miller and Urban 1999)



The parks' formal fire monitoring program began in 1982. The program initially focused on monitoring weather, fire behavior, vegetation, and dead and down surface fuels in giant sequoia groves. Over time, the monitoring program expanded to other vegetation communities as the prescribed fire program expanded.

While the monitoring program is designed to document changes that occur in areas where fire management activities take place, many factors (e.g. climate, pollution, pathogens) may play a role in ecosystem changes. If the monitoring program detects an unexpected change, a more detailed research project designed specifically to test a hypothesis may be needed to determine the cause of the change. A Research Plan describes, current, and potential research studies that could provide additional information to the fire management program (see Appendix D). Wherever possible, new information gained will be used to inform and improve the fire management and monitoring programs.

Following a summary of fire-related target conditions and management objectives, this monitoring plan is organized into several sections, each of which addresses a current component of the parks' fire monitoring program or identifies areas for future monitoring efforts. The individual sections describe the identified information need, the management targets/objectives (if developed), the monitoring objectives, and the monitoring design for the following resource components:

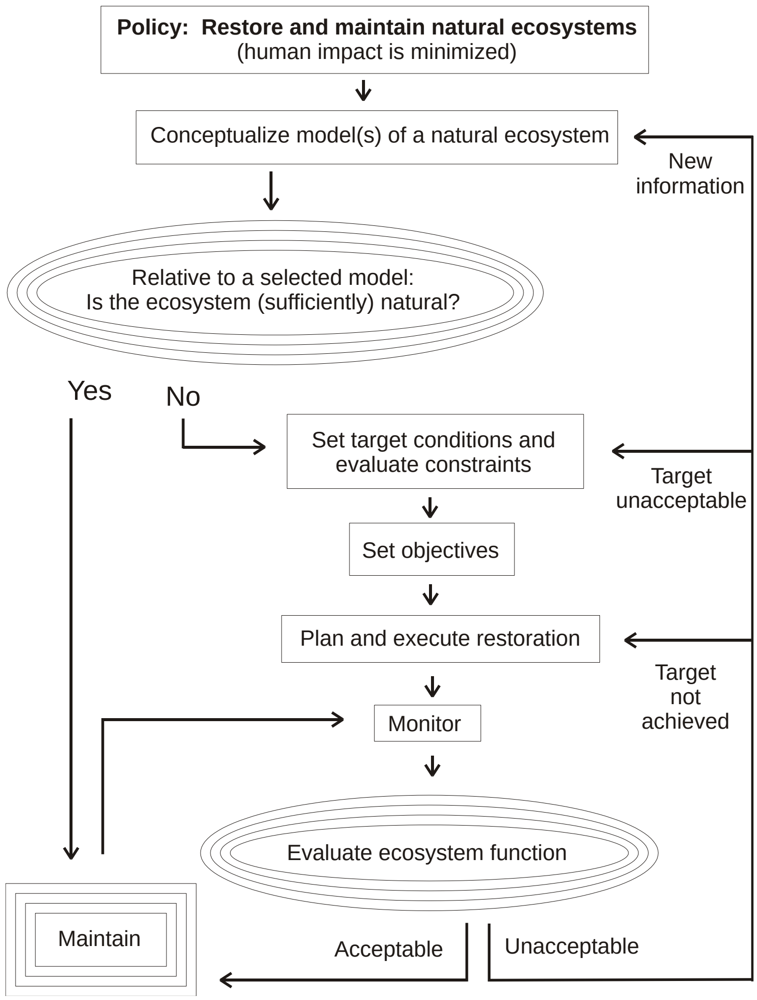
- Environmental and Fire Conditions
- Vegetation and Fuels
- Additional Fuels Information for Modeling
- Fire Regime
- Cultural Resources

Note that Air Quality monitoring is covered separately in Appendix J. Following the individual resource components sections, a brief section on monitoring program integration presents the relationships between the current components, as well as the need and plans for improved future integration.

TARGET CONDITIONS & SPECIFIC MANAGEMENT OBJECTIVES

An adaptive feedback process is used to guide and evaluate the fire and fuels management program (Figure 2). This process begins with policy direction and incorporates the most current information to make knowledge-based management decisions about how best to restore and maintain fire-related natural resource components and processes. These decisions are continuously evaluated based on monitoring results and new research and information is integrated to help guide the management program.

Figure C-2: Model of adaptive feedback process (Keeley and Stephenson 2000)



Fire management program goals and objectives are described in Chapter 2. One program objective is to understand the effects of fire management actions by monitoring and evaluating the effects of fire and fuels management activities on park natural and cultural resources with particular attention to vegetation, water, wildlife, air, and cultural resources. To accomplish this task, specific, measurable benchmarks may be needed as a point of reference to determine if the resource conditions resulting from fire management actions are meeting park goals for restoring and maintaining natural conditions. To answer the question, "What would the resource look like if we achieve our goals?", target conditions are needed to describe resource goals more specifically and to serve as a standard by which to measure fire management program success.

Information used to develop the target conditions includes research data when available, historic photos and written documents, and expert opinion. Target conditions must be periodically evaluated to determine whether they are still realistic and desirable in light of a changing environment. For example, target conditions may be based on our knowledge of past long-term climate conditions; however, future climate changes may preclude achieving these targets. The target conditions will be further refined as new research provides information that increases our knowledge of past, current, and future conditions.

To describe explicitly how to arrive at the target conditions, specific management objectives are developed by adding a method and timeframe to the target conditions. For example, if the target condition is a stand density of 20-250 trees/ha, then the management objective would be to use prescribed fire to reduce stand density to 20-250 trees/ha by 2 years following treatment. Target conditions and specific management objectives for each resource component, where developed, are described in the corresponding individual sections of this monitoring plan.

In areas of the parks currently in the restoration phase of the program, structural targets and objectives are used to assess program success. Once these structural conditions are restored, then the area moves into the maintenance phase of the program and process targets are used to evaluate the program goal achievement. Figure 3 illustrates the changing nature of targets/objectives over time from the restoration phase to the maintenance phase using an example of fuel load objectives.

Like target conditions, management objectives must be evaluated on a regular basis. As the monitoring results become available, they are used to determine if management objectives are achieved and to determine if management activities need to be adjusted. Also at this time, an assessment of whether the management objectives are still desired is warranted in light of ongoing monitoring results and any new information made available.

Some of the monitoring program components that follow have target conditions and specific management objectives defined, while others have only general goals outlined. Part of the next phase of the monitoring program includes identifying additional targets and management objectives, then developing associated monitoring objectives, and refining or adding protocols if necessary. In this way, we can be sure that the monitoring program will adequately assess the success of the fire management program. Any changes or additions will be included in future revisions of this fire monitoring plan.

Guidelines for monitoring fire or treatment effects within a framework of four monitoring levels (NPS 2008 RM-18):

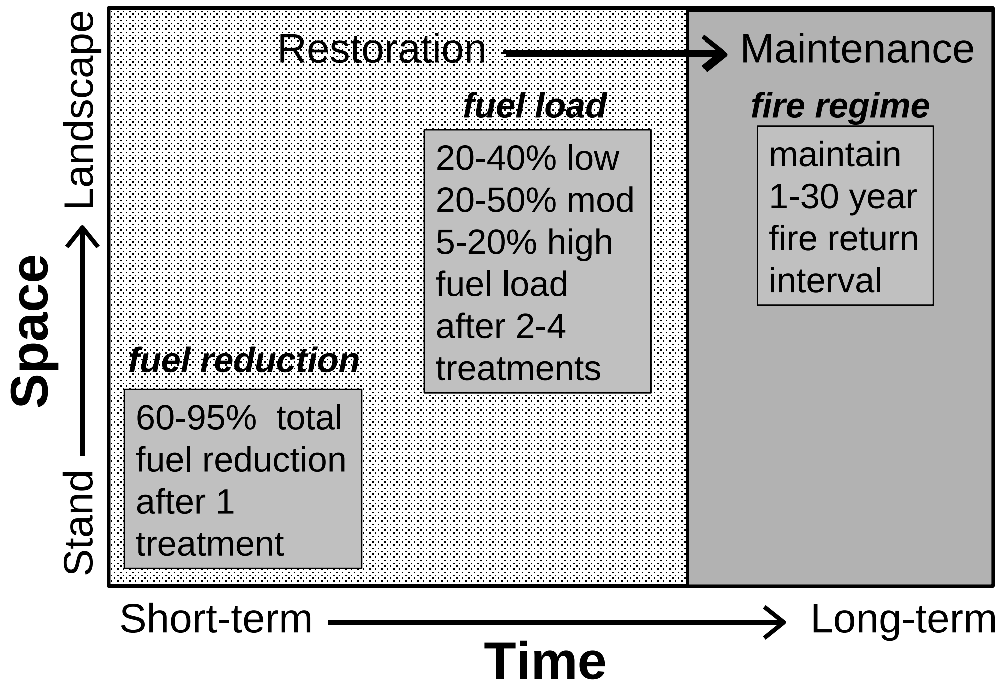
Environmental and Fire Conditions:

- Environmental (Level 1)
- Fire Observation (Level 2)

Vegetation and Fuels:

- Short-Term Change (Level 3)
- Long-Term Change (Level 4)

Figure C-3: Objectives change as the fire management program progresses over time and expands in spatial scale.



ENVIRONMENTAL & FIRE CONDITIONS

The first two monitoring levels described in the Fire Monitoring Handbook (FMH; National Park Service 2003), environmental monitoring and fire observations, provide information to guide fire management strategies for wildland and prescribed fires.

Monitoring Goal: Environmental monitoring and fire observations provide the basic background information needed for decision-making before, during, and after fire events.

Monitoring Objectives

1. Collect information on environmental conditions (weather [current and forecasted], fuel model) and fire conditions (name, location, slope, aspect, spread, intensity, smoke transport and dispersal) for all wildland and prescribed fires.

2. Use the information collected in a timely manner to adapt to changing conditions and successfully manage each fire.

Field Measurements

The following information will be collected for all wildland and prescribed fires: location, cause, current size, air temperature, relative humidity, wind speed, wind direction, percent slope, aspect, National Fire Danger Rating System (NFDRS) fuel model appropriate index (energy release component [ERC] or burning index [BI]), representative Fire Behavior Prediction System (FBPS) fuel model, rate of spread, direction of spread, flame length (or relative intensity), perimeter and area growth, and smoke transport and dispersal.

In addition to the data listed above, the following information will be collected for all prescribed fires: live fuel moisture (if applicable), dead fuel moisture (1 hour, 10 hour, 100 hour, 1000 hour, litter, duff) as indicated in the site specific burn plan prescriptions, road or sensitive site visibility, smoke column mixing height, smoke transport and dispersal direction. Smoke particulate data may be collected at smoke sensitive locations as indicated in the site-specific burn plan.

Timing of Monitoring

All prescribed fires will have the environmental conditions monitored at least two weeks in advance of the planned ignition date. On-site weather and fire condition monitoring will occur throughout all active ignition phases of each fire on a schedule determined by the burn boss with consultation from the lead monitor assigned to the fire.

The monitoring frequency and data collected for all wildland fires will be specified in the Wildland Fire Decision Support System (WFDSS).

Monitoring Site Location

On-site environmental conditions for all prescribed fires will be monitored at a representative location within the burn area, as determined by the burn boss with consultation from the lead monitor assigned to the burn. The weather conditions will be monitored using an existing representative fire weather station or if there is no representative station (as determined by the burn boss), a portable station will be set up on site.

Weather conditions for most wildland fires will be monitored using an existing representative fire weather station. On-site environmental and fire conditions for all wildland fires will be monitored as indicated in the WFDSS.

Data Analysis

Environmental monitoring and fire observations provide the basic background information needed for decision-making. For prescribed fires, the assigned monitor will relay the data to the burn boss and fire management staff on a regular basis (prior to the ignition of a prescribed fire, and at a predetermined interval during the active ignition phase to facilitate proper management). The burn boss will use the information to verify that the fire is within the prescribed conditions and to adjust the timing, quantity and spacing of new ignitions.

When environmental data from wildland fires is collected, it will be transmitted to the incident commander as soon as possible to facilitate the proper and timely management of the fire. On longer duration fires, the data may be used to create weather, wind and fuel moisture input files needed for fire spread simulation. The outputs from the fire spread projections will be used to estimate the fire's arrival to areas of concern and allow for enough time to plan for the protection or mitigation efforts needed. The parks' fire staff may also use the data to adjust and run risk assessment models.

Data Sheet Examples

Data sheets used to collect information include a weather observation form, fire behavior observation form, smoke observation form, fuel moisture summary form, monitoring report outline, and wildland fire observation summary form (see Attachment 1).

Information Management

All original data sheets and summary reports will be kept in the permanent fire folder located in fire dispatch. Electronic file copies will also be placed in the fire folder when available. The permanent fire folder will be kept in accordance with Appendix Q (Wildland Fire and Fuels Management Reporting Requirements) of the Fire and Fuels Management Plan.

Quality Control

Monitoring personnel will receive appropriate training each season under the direction of the fire monitoring crew supervisor. This training will cover the proper protocols for collection and transmission of environmental and fire conditions data. New monitors will receive a minimum of two training assignments before they can function as a lead monitor. The appropriate supervisor will review all summary reports prior to placement in the fire folder.

Responsible Party

The person in charge of the fire (burn boss, or incident commander) is responsible for ensuring that the environmental data is collected, transmitted, acted upon, and filed according to established protocols.

Funding

All fire expenditures (personnel, aircraft, equipment and supplies) that are not covered by existing base accounts will be charged to the appropriate fire account. All expenditures will be tracked and reported according to the standards established in the Wildland Fire Report Form. All fires will have an appropriate fire management accounting code (prescribed or wildland fire).

Management Implications of Monitoring Results

Because environmental and fire condition monitoring is essential background information needed for effective decision making, the success or failure of a fire could very well depend on the proper and timely collection and transmission of this data. When properly executed, feedback from the monitoring of environmental and fire conditions will directly affect how the fire is managed. If a prescribed fire has exceeded the prescribed conditions, the field monitor will notify the burn boss who will limit any new ignitions and evaluate the situation. For wildland fires, the parks' fire managers will use the information to prioritize fires for assignment of critical resources. For example, a wildland fire that is being suppressed might receive more resources quickly if information relayed indicates that the fire is about to spread into a different fuel type that will result in a higher resistance to control. For use of wildland fire projects, the environmental and fire conditions information will be used to help determine the level of monitoring needed for each fire.

VEGETATION AND FUELS

Monitoring levels 3 and 4 of the Fire Monitoring Handbook (FMH; National Park Service 2003), describe short- and long-term monitoring of the effects of fire on fuels and vegetation to guide prescribed fire management strategies. Additionally, the park is developing a set of protocols for a "rapid assessment plot" (RAP) to be used for prefire and immediate postfire fuel changes. While the standard vegetation and fuels monitoring component applies primarily to prescribed fire, monitoring wildland fire and mechanical fuel removal activities and unburned areas will be undertaken when a particular need or opportunity arise.

Monitoring Goal: Vegetation and fuels monitoring provides information needed to determine whether management objectives are met and to detect any unexpected consequences of prescribed burning or other treatments.

Target Conditions

Fire-related vegetation and fuels target conditions for each vegetation type within the parks were developed by a team of scientists and park managers using the best available information about conditions present in the parks during the 1,000 years prior to Euro American settlement. These target conditions are divided into two types of conditions, structural targets for the restoration phase of the program and process targets for the maintenance phase of the program (Table 1). Targets for structure describe attributes of the dominant vegetation and were developed for areas being initially treated with prescribed fire to restore conditions significantly altered by fire exclusion. Structural target conditions were not developed for vegetation types where the structure has not been greatly altered by fire exclusion (e.g. historic fire return intervals are as long as or longer than the period of fire exclusion). Targets for process describe attributes of the historic fire regime and are applied to areas that have not been greatly altered by fire exclusion or areas where conditions have been restored with prescribed fire.

Table C-1: Target conditions by vegetation type. Restoration phase targets (structure) are in un-shaded cells and maintenance phase targets (process) are indicated by shaded cells

Vegetation Type	Fuel Reduction [restoration]	Stand Density by diameter class & spp. comp. [restoration]	Fuel Load Distribution (% of landscape) [maintenance]	Gap/Patch Size Distribution (% of landscape) [maintenance]
Ponderosa pine-mixed conifer	60-95% total fuel reduction	50-250 trees/ha <80 cm 10-75 trees/ha 80 cm (50-80% pine, 5-20% fir, 10-20% cedar, 1-10% oak)	20-40% 5-30 tons/acre 20-50% 30-60 tons/ac 5-20% >60 tons/acre	75-95% 0.1-1 ha 5-25% 1-10 ha <1% 10-100 ha (% is percent of landscape)
White fir-mixed conifer	60-95% total fuel reduction	50-250 trees/ha <80 cm 10-75 trees/ha ≥80 cm (40-80% fir, 15-40% pine, 0-20% cedar)	20-40% 5-30 tons/acre 20-50% 30-60 tons/ac 5-20% >60 tons/acre	75-95% 0.1-1 ha 5-25% 1-10 ha <1% 10-100 ha
Giant sequoia-mixed conifer *	60-95% total fuel reduction	50-250 trees/ha <80 cm 10-75 trees/ha ≥80 cm (40-80% fir, 10-40% sequoia, 5-20% pine)	20-40% 5-30 tons/acre 20-50% 30-60 tons/ac 5-20% >60 tons/acre	75-95% 0.1-1 ha 5-25% 1-10 ha <1% 10-100 ha
Subalpine	NA	NA	NA	NA (woodland type)
Xeric conifer / montane chaparral	NA	10-150 trees/ha <80 cm 5-50 trees/ha ≥80 cm (60-80% pine, 20-40% fir)	1-30% 5-10 tons/acre 25-75% 10-30 tons/ac 1-10% >30 tons/acre	NA (woodland/ savannah type)
Red fir	60-95% total	50-500 trees/ha <80 cm	1-25% 5-30 tons/acre	70-95% 0.1-1 ha

Vegetation Type	Fuel Reduction [restoration]	Stand Density by diameter class & spp. comp. [restoration]	Fuel Load Distribution (% of landscape) [maintenance]	Gap/Patch Size Distribution (% of landscape) [maintenance]
	fuel reduction	10-75 trees/ha ≥80 cm (70-100% fir, 0-30% pine)	30-70% 30-60 tons/ac 5-20% >60 tons/acre	5-30% 1-10 ha <1% 10-100 ha (0-1% <1 yr gaps)
Lodgepole pine	NA	NA	not yet developed	not yet developed
Mid-elevation hardwood	NA	20-200 trees/ha <80 cm 10-50 trees/ha ≥80 cm (50-80% oak, 10-40% pine, 1-10% cedar)	40-60% 5-20 tons/acre 10-40% 20-50 tons/ac 0-15% >50 tons/acre	NA (woodland type)
Oak woodland	NA	20-150 trees/ha 10-50 cm 5-50 trees/ha ≥50 cm (80-100% oak, 0-20% other)	90-95% 0-1 ton/acre 5-10% 1-4 tons/acre	NA (woodland type)
Foothill chaparral	NA	25% 0-20 yr old stands 50% 20-50 yr old stands 25% >50 yr old stands (species composition varies depending on FRI)	NA	0.1 – 2000 ha (same as fire size)

* Note: An additional goal to perpetuate giant sequoias does not currently have specific, quantitative objectives defined, but the monitoring program tracks mature tree mortality and regeneration and recruitment of giant sequoias. In addition to the standard monitoring protocols, projects to track giant sequoia post-burn effects and to monitor sequoia seedling survival in reburns are described in the Additional Projects section below.

Monitoring Objectives

Specific fire-related management objectives that describe how to reach the target conditions were developed (Table 2). Explicit monitoring objectives were then established so that results from the vegetation and fuels monitoring program will be able to provide sufficient information to determine whether the corresponding management objectives have been achieved. The monitoring objectives specify what is to be measured (variables), what time interval to measure, and the level of certainty desired in the results. This information is then used to calculate the minimum sample size necessary to obtain the level of certainty needed in the results.

Table C-2: Vegetation and fuels management objectives and monitoring objectives. Restoration (structure) objectives are in un-shaded cells and maintenance (process) objectives are in shaded cells

Variable and Vegetation Type	Management Objective (restatement of applicable target conditions from Table 1)	Monitoring Objective
Fuel Load *[restoration]* All Forest Types	Reduce total dead and down fuel load by 60-95% immediately following initial treatment with prescribed fire.	Measure total fuel load with a sample size sufficient to have an 80% probability of detecting at least a 40% reduction in mean total fuel load immediately postburn. A 20% chance that a change will be detected when a real change does not occur is acceptable.
Fuel Load [*maintenance*] Mixed- Conifer Forest	Use fire to maintain fuel load mosaic across the landscape as follows: 20-40% 5-30 tons/acre 20-50% 30-60 tons/acre 5-20% >60 tons/acre Note: % is percent of landscape for all Mixed-Conifer Forest types.	Measure total fuel load with a sample size sufficient to have an 80% probability of being within 25% of the true mean total fuel load for all time intervals of interest.
Fuel Load *[maintenance]* Red Fir Forest	Use fire to maintain fuel load mosaic across the landscape as follows: 1-25% 5-30 tons/acre 30-70% 30-60 tons/acre 5-20% >60 tons/acre Note: % is percent of landscape in Red Fir forest.	
Stand Structure *[restoration]* Mixed-Conifer Forest	Use prescribed fire to restore mixed-conifer forest mean stand density to: 50-250 trees/ha for trees <80 cm DBH 10-75 trees/ha for trees ≥80 cm DBH by 5-years following initial treatment with prescribed fire. Species composition by forest type: Ponderosa pine – 50-80% pine, 5-20% fir, 10-20% cedar, 1-10% oak; White fir – 40-80% fir, 15-40% pine, 0-20% cedar; Giant sequoia – 40-80% fir, 10-40% sequoia, 5-20% pine.	Measure total tree density with a sample size sufficient to have an 80% probability that the 5-year postburn mean total density of trees <80 cm in diameter at breast height (DBH) and trees ≥80 cm DBH is within 25% of the true population means.
Stand Structure [*restoration*] Red Fir Forest	Use prescribed fire to restore red fir forest mean stand density to: 50-500 trees/ha for trees <80 cm DBH 10-75 trees/ha for trees ≥80 cm DBH by 5-years following initial treatment with prescribed fire. Species composition: 70-100% fir, 0-30% pine.	
Landscape Pattern [*maintenance*] Mixed-Conifer Forest Types	Use fire to maintain the distribution of gaps/patches across the landscape as follows: 75-95% 0.1-1 ha gaps/patches 5-25% 1-10 ha gaps/patches <1% 10-100 ha gaps/patches Note: % is percent of landscape comprised of gaps of each size class.	Note: Monitoring methods for assessing landscape pattern objectives have yet to be developed. These variables will likely be

Variable and Vegetation Type	Management Objective (restatement of applicable target conditions from Table 1)	Monitoring Objective
Landscape Pattern [*maintenance*] Red Fir Forest	Use fire to maintain the distribution of gaps/patches across the landscape as follows: 70-95% 0.1-1 ha gaps/patches 5-30% 1-10 ha gaps/patches <1% 10-100 ha gaps/patches	
Stand Structure *[*maintenance*]* Brush Types	Use fire to maintain a shrub stand age structure mosaic across the landscape as follows: 20-30% 0-20 year old stands 40-60% 20-50 year old stands 20-30% >50 year old stands. Note: species composition varies depending on fire return interval.	Measure live shrub cover with a sample size sufficient to have an 80% probability of being within 25% of the true pre-burn mean live shrub percent cover. (Note: This objective may be better monitored by using the time since last fire GIS layer; see Fire Regime section H; species composition may still require plot-level monitoring).

Target conditions developed for stand structure in brush types focus on maintenance of stand age classes. Since no specific objectives for restoring shrub cover currently exist, the monitoring objective focuses on getting good estimates of the pre-burn shrub cover conditions until further target conditions are developed.

In vegetation types where fire exclusion has not greatly altered the structure, target conditions were not developed, therefore, specific management objectives and monitoring objectives have also not been developed for these vegetation types. In addition, monitoring methods for assessing landscape pattern objectives have yet to be developed. Variables such as gap size and distribution across the landscape will likely be measured using some type of remote sensing (e.g. Landsat TM, aerial photography, LIDAR, etc.). These will generally require some kind of ground truthing, such as “composite burn index” (CBI) plots for dNBR data derived from Landsat images. Monitoring for other objectives related to maintaining the natural process of fire are discussed in the Fire Regime section (section H) of this plan.

Sampling Design

The sampling design is intended to allow the monitoring objectives to be achieved as efficiently as possible. The vegetation and fuels monitoring program generally follows the NPS Fire Monitoring Handbook (FMH; National Park Service 2003) protocols, with some deviations because the parks’ program was initiated prior to the NPS program. Currently, eight monitoring types (combination of vegetation type, fuel model, and burn prescription) exist, of which seven describe the vegetation and fuels located in areas where prescribed burning occurs. One monitoring type is associated with an area burned during use of wildland fire. See Attachment 2 for current monitoring type descriptions.

For each monitoring type, the minimum sample size was calculated to determine the number of plots needed to achieve the monitoring objectives as efficiently as possible. This information, along with the current plots installed and new plots planned, comprises the plot installation plan (Table 3).

Table C-3: Vegetation and fuels monitoring plot installation plan

Monitoring Type Name	Minimum Sample Size*		Current # of Plots	# of New Plots Planned	Total # of Plots
	Total Fuel Reduced.	Density (<80 cm, ≥80cm) or % Cover			
Ponderosa pine-dominated forest	5	1, #	4	6	10
Low elevation-mixed conifer forest	4	7, 29	5	5	10
White fir-mixed conifer forest	12	3, 7	12	1	13
Giant sequoia-mixed conifer forest	5	10, 9	30	1	30
Red fir forest	#	# , #	6	4	10
Xeric Jeffrey pine forest	#	#, #	5	4	10
Chamise chaparral	-	1	3	0	3
Mixed chaparral	-	2	6	4	10
Montane chaparral‡	‡	‡	4	0	4
TOTAL			68	22	90

Key:
* Minimum sample size was calculated for objective variables. In all forest types, calculations were performed for immediate-post burn total fuel reduction (precision, R=25; confidence level, α= 80%, power=80%, minimum detectable change=40%) and 5-year postburn total tree density for trees <80 cm DBH and ≥80 cm DBH (precision, R=25; confidence level, α=80%). In all brush types, calculations were performed for pre-burn live total shrub cover (precision R=25, confidence level, α=80%).
\# A minimum sample size for this category is not available because it is either not applicable or there are not enough plots or data to calculate.
‡ Monitoring type associated only with wildland fire project; no minimum sample size calculated.

Current Plans by Monitoring Type

Ponderosa pine-dominated forest – Although we only need to install one more burn plot to reach the minimum sample size, this type is of particular interest regionally and nationally, therefore, we would like to increase the number of burn plots to ten, if possible. Due to the limited distribution of this type in the park (restricted primarily to Cedar Grove) and the extent of the type already burned, we may have difficulty reaching ten plots. There is a need to investigate the role of fire and other factors in a locally severe cheatgrass (Bromus tectorum) invasion.

Low elevation-mixed conifer forest – We are scheduled to install five more burn plots in this type in order to achieve an initial ten burn plots with which to calculate the minimum sample size. Based on calculations using the five plots that have reached the 5-year post-burn stage, the number of burn plots needed to achieve the monitoring objective for smaller diameter tree density is excessive. This number of plots may decrease after the additional burn plots are installed and the sample size is recalculated.

White fir-mixed conifer forest – We have nearly reached the minimum sample size for this type and we are scheduled to install two more burn plots in the East Fork Kaweah Fire Management Unit (FMU) in order to have vegetation types better represented within this watershed (three burn plots), where the program has focused on larger landscape-scale prescribed fire.

Giant sequoia-mixed conifer forest – One more burn plot is scheduled for installation in the East Fork Kaweah FMU to achieve better representation within the watershed (three plots). Otherwise, we have well exceeded the minimum sample size needed for the monitoring objectives in this type.

Red fir forest – We are planning to install at least four more plots, for a total of ten initial plots. Although six plots have been installed, only two plots have burned and therefore we will calculate minimum sample size when a few more plots have burned.

Xeric Jeffrey pine forest - We are planning to install at least four more burn plots, for a total of ten initial plots. Six plots have burned (some of these were reclasses ponderosa plots) and will be used to calculate minimum sample size.

Chamise chaparral – We have achieved the minimum sample size for this type and do not plan on installing any more plots.

Mixed chaparral – Although we have exceeded the minimum sample size needed in this type, we plan to install four more plots so that the plots are somewhat more geographically distributed.

Montane chaparral – Prescribed burning has been limited in this monitoring type in the past. The current plots in this monitoring type were opportunistically installed within a use if wildland fire project and were all burned in one event. If prescribed burning is carried out in this vegetation type according to the 5-year burn plan (1800 acres), more monitoring plots may be installed.

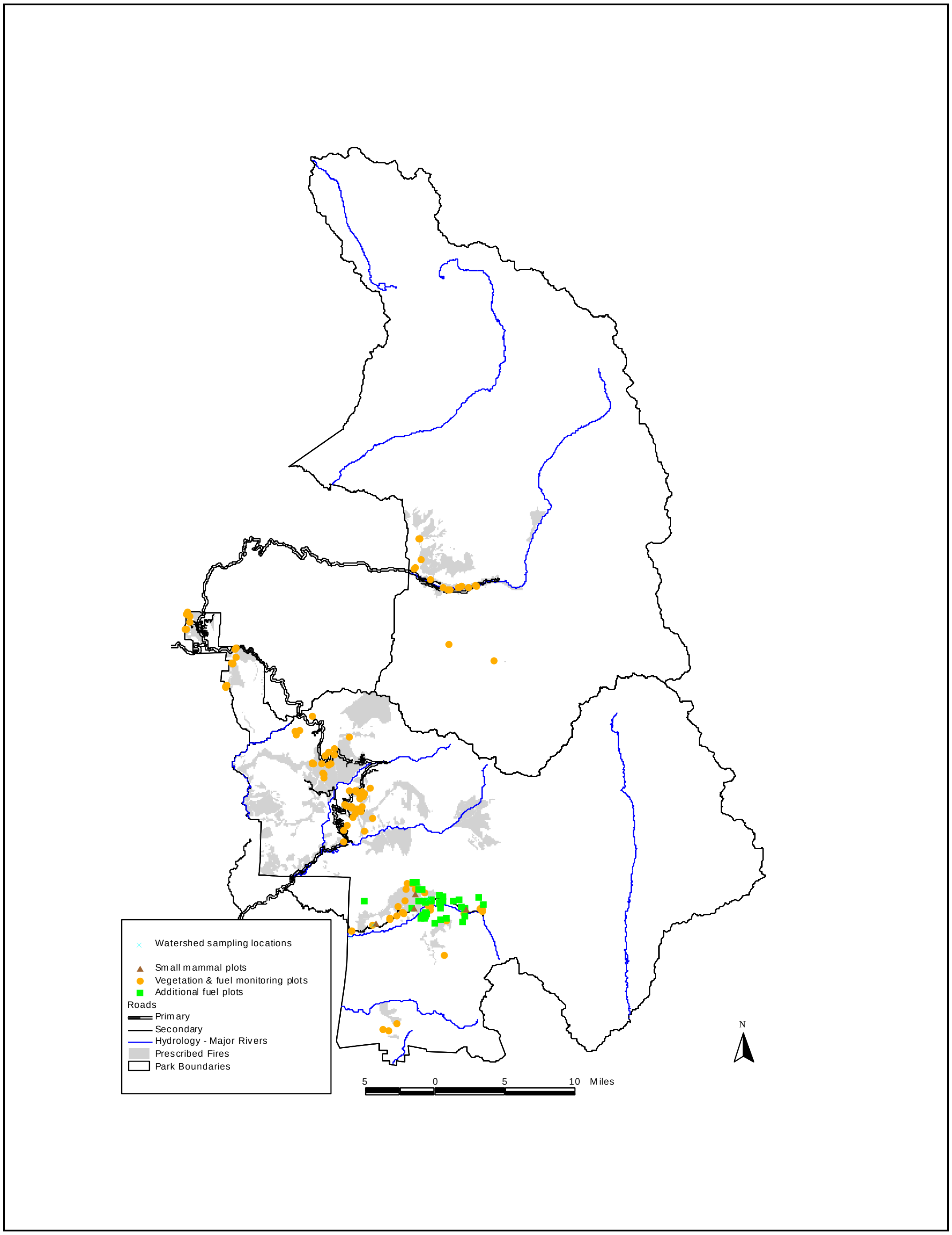
New Monitoring Types – Several new monitoring types may be needed based on the current 5-year burn plan. These monitoring types include foothill hardwoods and grassland, and mid-elevation hardwood forest. In the past, prescribed burning in these types has been limited, but if the amount of prescribed burning increases, we will need to address these types. We have also discussed monitoring in our Ash Mountain development hazard fuel reduction burns primarily to monitor native vs. non-native dynamics. We have not yet had the time to carry out this monitoring as it has not been a high priority, but it may be included in future monitoring efforts.

Pilot sampling will occur prior to monitoring in any new vegetation types to be sure that the future monitoring efforts are as efficient and effective as possible.

Plot Distribution

Many of the existing permanent plots were installed prior to the establishment of the FMH program within the region. Little formal documentation exists on the method used for selecting burn units in which these monitoring plots were located prior to 1992. From the information we have, these early plots were randomly located within areas scheduled for burning within the near future and were stratified by monitoring type. Plots installed between 1992 and 1996 were distributed randomly in areas scheduled for burning within the subsequent five years, stratified by monitoring type. Plots installed after 1996 were distributed using a "restricted random" design to avoid spatial clumping of plots. Current plot locations and associated burn unit boundaries are shown in Figure 4.

Figure C-4: Map of current monitoring plot locations. Burn units shown in shaded areas



Field Measurements

The field measurement protocols follow those found in the NPS Fire Monitoring Handbook (National Park Service 2003) with the following exceptions:

1. The parks' tree size definition is as follows:

- Overstory trees are those trees reaching breast height and greater.
- Seedling trees are those trees less than breast height.
- The parks do not distinguish pole-size trees as defined in the FMH.

These categories have been maintained because: 1) they are standard parkwide definitions used in previous and ongoing research, and 2) they were in place prior to the FMH guidelines and long-term consistency is extremely important. The tree diameter breakdown can be changed relatively easily by data manipulation, if necessary, so that the protocol deviation only affects trees in the seedling size class.

2. During sampling of brush monitoring types, measuring brush density of some of the species proved very difficult. Even for some of the species that are not clonal, distinguishing among individuals can be difficult as the stems grow very close together, often in clumps; determining if the stems are attached or separate can sometimes only be accomplished by excavation. We found that counting individual plants is not repeatable among crew members, leading us to be concerned about the reliability of density measurements for these brush species. We are unable to get repeatable data and are concerned that to do so correctly would require highly disruptive and time-consuming methods (i.e. digging). In addition, our current efforts to develop management objectives for chaparral are focused on brush cover and not density, therefore, we will not collect brush density measurements in these areas unless our management objectives change.

3. The original method used for measuring herbaceous vegetation was a line-intercept method when the program began in 1982, therefore, all plots installed prior to 1989 used this method. All plots installed after 1989 use the current point-line intercept standard method outlined in the FMH (National Park Service 2001). Beginning in 1992, conversion of pre-1989 plots to the new method began by performing both measurement techniques until the plots were burned again, and thereafter switching to the point-line intercept method. In this way, herbaceous vegetation sampling on all plots will eventually use the same method (point-line intercept).

Timing of Monitoring

All plots currently follow the monitoring frequency recommended in the FMH: pre-burn, immediately postburn, 1-year, 5-years, and 10-years postburn or until burned again (National Park Service 2003). Once a monitoring plot is burned again, the same frequency of monitoring is repeated. Preburn monitoring should also occur within three years of a burn treatment. Deviations to this frequency occurred prior to the existence of the NPS monitoring program when plots installed prior to 1989 were not usually re-measured 2-years postburn. Two-years postburn monitoring was again discontinued in 2011. The master plot list (matrix_"date".xls) in the FMH spreadsheet, lists these individual plot monitoring frequency deviations in the comments field. In addition, occasionally a plot re-measurement was not possible due to late season weather or limited monitoring resources. Again, in these cases, the frequency deviations are listed in the comments (J:\seki\park_programs\share_docs\fire\Ecology\effects\plots\fmh\plot_sampling_schedule) field of the FMH spreadsheet master plot list.

Monitoring Plot Relocation

All monitoring plots are permanently marked with painted steel bars with labeled tags according to the FMH recommended standards (National Park Service 2003). All plots have written descriptions of their location, hand drawn maps, and are geo-referenced using a GPS unit (a few plots have not yet been geo-referenced but will be on their next visit). The plots will be relocated using a combination of the above references. Copies of all plot location description sheets (FMH-5) are stored with the Regional Fire Effects Monitoring Program Manager in the Pacific West Regional office in Oakland. All updated vegetation and fuels plot locations (UTM coordinates) are stored on the parks' local area network
J:\seki\park_programs\Data\study_sites\MASTER_DATA and
J:\seki\park_programs\share_docs\fire\Ecology\effects\plots\GPS UTM plot location

Data Analysis

Data from the standard vegetation and fuels monitoring program, along with the other projects that supplement the standard program (see Additional Projects section below), provide the following results (bold indicates results related to management objectives):

- dead and down fuel reduction and accumulation
- changes in overstory tree density and species composition by diameter class and condition
- changes in seedling tree density and species composition by height class
- changes in snag density and snag formation/breakdown rates
- changes in shrub density (or cover) and species composition
- changes in cover and species composition of herbaceous vegetation
- changes in ground cover
- changes in species richness
- detection of non-native species
- burn severity
- immediate-postburn effects on trees (maximum bark char and crown scorch heights, percent crown scorch)
- mortality of large pines with and without basal fuel removal
- mortality and survival of postfire-regenerated giant sequoia seedlings following subsequent prescribed fire treatment.

Results for all objective variables are analyzed on an annual basis and presented in the program annual report. Currently, the analyses that are directly tied to specific management objectives in forest monitoring types are:

1. Mean total fuel reduction immediately following prescribed fire, and

2. Mean stand density (by diameter class and species) five years following prescribed fire.

For fuel reduction objectives, we calculate the 80% confidence interval of the mean percent total fuel reduction (average change of individual plot fuel reduction) to determine whether postburn fuel reduction estimates fall with the range set in the objectives. For stand density objectives, we use the 80% confidence interval of the 5-year postburn stand density to measure whether stand density estimates falls within the targeted range for both tree diameter classes (<80 cm and ≥80 cm). In addition, we examine the species composition (by density) to determine whether it falls within the targeted ranges. While the time period for stand density objectives is five years, we analyze stand density one and two years following prescribed fire in order to evaluate progress towards achieving the targets as the majority of tree mortality occurs during that time period.

The park has also developed a set of protocols for a "rapid assessment plot" (RAP) to be used for prefire and immediate postfire site changes. They provide data on fuels, overstory tree composition, and fire severity and are sampled within the predominant fuel model types (Scott and Burgan 2005) within each burn unit using a stratified random sample method. Each plot consists of a 30 m base transect off of which three Browns fuels transects are run. Plots are removed following the postburn sampling.

Methods to measure landscape pattern of change due to fire have been implemented for large fire s (>300 ac). They include the use dNBR and RdNBR (differenced normalized burn ratio and relative differenced normalized burn ratio respectively) values derived from prefire and one-year postfire LandSat images. Ground truthing and adjustment of these values is done using composite burn index (CBI) sampling using stratifies random sampling with each major vegetation type and burn severity class within the large burns. Also, as other new objectives are developed, additional corresponding analyses will be warranted.

Additional analyses using several data sources are performed on an annual basis include fuel reduction and accumulation over time by fuel component (litter, duff, and wood) and stand density changes 10 years following prescribed fire. These analyses are useful in helping to determine when areas will be scheduled for subsequent treatment with prescribed fire (e.g. How long after initial treatment before fuel loads approach pre-burn levels?). The long-term analyses are also useful in assessing whether giant sequoia recruitment is occurring in areas burned, important for the parks' goal of perpetuating giant sequoias. Changes in shrub cover by species composition are also analyzed in brush monitoring types while specific objectives for the brush types are still in development.

Data Sheet Examples

Data sheets used for monitoring are those found in the FMH, Appendix A (National Park Service 2003). Local modifications of these standardized data sheets are stored in the forms file drawer in the fire effects monitoring program office.

Information Management

The most current copy of the digital database is located on the parks' local area network (J:\seki\park_programs\Data\plants\fire_effects\vegetation_fuels_ffi\primary_data). All raw data sheets (stored in folders by plot) and photographic slide files are located at the fire effects monitoring program office at the parks' Ash Mountain headquarters. Data is maintained in the FFI database. The updated database resides on the park server (INPSEKIHQGIS3) backed up daily by park IT as well as the Ecologist's residence. Copies of the database files, plot location descriptions and maps, and an annual copy of the digital database are stored with the Regional Fire Effects Monitoring Program Manager in the Pacific West Regional office in Oakland.

All data and work schedules for additional projects (see section below on Additional Projects) are stored on the fire effects crew computer in the central room of fire effects office (J:\seki\park_programs\share_docs\fire\Ecology\effects\crew projects). Data files are backed up on the parks' LAN (J:\seki\park_programs\Data\plants\fire_effects\sequoia_mortality\primary_data_N27). Plot locations for other projects are being obtained and will be added to the permanent plot database on the network (J:\seki\park_programs\share_docs\fire\Ecology\effects\plots\GPS UTM plot location updates).

A report prepared annually summarizes program accomplishments and monitoring results and is distributed to the park staff, the Regional Program Manager, and other interested parties. The annual reports are stored on the parks' LAN (J:\seki\park_programs\Data\plants\fire_effects\vegetation_fuels_ffi\products\annual_reports.

Quality Control

Quality control is of the utmost importance in all aspects of the vegetation and fuels monitoring program. Without high quality data the monitoring program cannot accurately assess whether management objectives are achieved. Therefore, multiple levels of quality control will be performed at all stages of the program using the following techniques:

1) Data Collection

a) Training – At the start of each season, several days of sampling protocol training where each protocol is demonstrated and then each employee performs the protocol. This training is followed by a practice plot session where all protocols are practiced in a real plot setting.

b) Periodic in-field comparisons – A few plots are randomly selected (up to 10%) and for these plots the data are collected independently by two different observers. The data from the independent observations are compared to examine the precision of the data. This technique is most useful to point out areas where measurement error is most problematic and to increase awareness of field protocols where more care is needed in measurement.

c) Field Data Checklist (see Attachment 1) – For each plot visit, a checklist of all field tasks is filled out and the lead monitor makes sure that the checklist is complete and that all completed datasheets are placed in the plot folder before leaving the field site. See J:\seki\park_programs\share_docs\fire\Ecology\effects\Data Management\SEKI FEM Data Management.xlsx.

2) Data Storage

Quality Check Log (Attachment 1) – This log sheet is used to be certain that the data are entered into the database completely and accurately. After each field datasheet is entered into the database, the corresponding entry on the Quality Check Log is checked off, initialed, and dated by the person(s) who performed the data entry. At a later date, the field datasheet (raw data) is independently compared to the database and any errors in data entry are corrected. Each datasheet verified is checked off, initialed, and dated by the person performing the quality check on the Quality Check Log, which is stored with the data in the plot folder as a record of quality control. The Quality Check Log also serves as a place to record any questions or discrepancies found in the data or any information that needs to be gathered during the next visit to the plot. See J:\seki\park_programs\share_docs\fire\Ecology\effects\Data Management\SEKI FEM Data Management.xlsx.

3) Data Analysis

a) Identify anomalies – Any anomalous results which become apparent during data analysis are investigated for potential data errors. First, the corresponding field datasheets are examined for any visible errors and then compared to the database to check for errors in data entry.

b) Repeat analyses – Analyses are repeated in order to be certain that the correct analyses were performed and that the same results are generated.

Program reviews will occur periodically, either every 5 years, or at the request of the park Ecologist park Fire Management Officer, or the Regional Program Manager.

Responsible Party

The Lead Biological Science Technician (Fire Effects/Monitoring), in coordination with the Ecologist (Fire Effects) is responsible for hiring and training seasonal fire effects monitors, collecting field data, storing data electronically, performing data quality checks, and assisting with data analysis as needed.

The Fire Ecologist, in coordination with the Supervisory Natural Resource Management Specialist and the Fire Management Officer, is responsible for developing monitoring objectives, determining the appropriate sampling design, managing the database (including backups and quality control), analyzing the data, and disseminating the results for the vegetation and fuels monitoring program.

Funding

Funding for vegetation and fuels monitoring will be obtained through the current NPS fire funding analysis system. Individual project accounts will be used to cover any additional time needed beyond base funding to monitor burning plots and immediate post burn visits.

Additional Projects

The following studies, carried out as time permits complement the parks' network of vegetation and fuels monitoring plots and provide additional information important to the fire management program.

Increasing giant sequoia sample size

Because of their great size, giant sequoia tree density is very low in the standard 20 x 50 m forest plots. To increase the sample size of giant sequoia, we sample all, or a subset of, giant sequoia trees in prescribed burn units in the Giant Forest area prior to and following prescribed burning. Pre- and post-burn methods follow the FMH protocol for overstory tree sampling and can be combined with the FMH database for the Giant sequoia-mixed conifer forest monitoring type. The total number of giant sequoias sampled in this study to date is 983 trees in seven separate units burned between 1993 and 2010. This information will provide a sufficient monitoring sample depth over a long time period with which to assess the long-term effects of prescribed fire on mature giant sequoia trees. Monitoring will continue for trees currently sampled, however, no additional giant sequoias will be added to the sample unless specific reasons warrant it.

Giant sequoia seedling survival in reburns

The issue of subsequent burns, following the initial restoration burn, has recently become timelier. Some areas of the parks where early prescribed burning efforts were concentrated have already surpassed the historic fire return interval without subsequent burning. In some of these areas, giant sequoia regeneration of varying density resulted from the initial burn. Knowledge about fire effects on these young trees following subsequent prescribed burns is critical, especially given the importance of giant sequoias and their fire-dependent regeneration. Plots were installed in reburn areas specifically to assess the reburn mortality/survival of groups of giant sequoia seedlings that established after the initial burn. This information may be helpful for decisions related to reburn scheduling in other areas in the parks.

Wildland-Urban Interface

In response to the National Fire Plan (2001), Sequoia and Kings Canyon National Parks identified Wildland-Urban Interface (WUI) areas that are treated to reduce the threat of damage to structures (both public and private) from wildland fire. This treatment involves the removal of fuel (both dead and live vegetation) from around the structures and includes mechanical thinning of small trees and brush, piling surface fuels, and burning the resulting piles of fuel removed.

Specifications for the fuel removal work will be located in individual mechanical treatment plans. In order to determine whether the treatments have been effective, pre- and post-treatment monitoring is carried out according to the following general protocols that may be adjusted depending on the project area:

Prior to treatment, permanent plots will be installed along the outside edge of the project area (200 feet from structures) looking back in towards the developed area. Previous experience has shown that 15-20 sample points will generate adequate data to represent the area statistically, and these points should be distributed evenly around the project area. The sample point will be marked by a single rebar stake that will be painted orange to facilitate relocation. The rebar stake will have a tag that identifies the project name and plot number.

A photo series estimate of the total woody fuel load will be taken from this point looking back into the project area with the plot centerline being perpendicular to the outside edge of the project. The photo series estimate will go out from the sample point at 45 degree angles from either side of the stake out for 100 feet. The total fuel load estimate will be recorded along with the plot number.

At each point, 100 feet in to the project area along the plot centerline, a chaining pin will be placed into the ground. A tape measure will be swung around this chaining pin for a radius of 100 feet. All trees less than 40 feet tall within this radius will be recorded. Trees that are close to 40 tall will be measured using a clinometer and tape, to accurately estimate the tree height.

The plot will be reread immediately following the completion of the project to determine if the objectives have been met, and then follow the standard FMH plot monitoring timing.. When the total woody fuel load exceeds 12 tons/acre, additional piling of fuels and burning of the piles will occur. When the total number of trees less than 40 feet tall exceeds 25/acre, additional thinning, piling and burning will occur. When maintenance activity occurs, the plots will be reread to assure the treatment objectives are being met. The area will be maintained into the future so that the project objectives are met.

The Fire Effects/Monitoring Crew Supervisor, in coordination with the Fuels Specialist and Assistant Fuels Specialist, is responsible for completion of the WUI monitoring work.

In addition to monitoring the treatment objectives (above), comparing the results of mechanical fuel removal with similar areas treated with prescribed fire may provide useful information to evaluate the effects of alternative fire management activities. Up to three standard fuel and vegetation monitoring plots will be installed within the project area in order to compare results to those from similar areas treated with prescribed fire. Although only limited information will be gained from such a small sample size, differences in vegetation composition and patterns may be documented and investigated further if necessary. Fuel accumulation rate and tree regeneration will also be documented in the plots. The Lead Biological Science Technician (Fire Effects/Monitoring), in coordination with the Fire Ecologist is responsible for implementing this supplementary WUI monitoring.

Due to additional concerns about the potential for non-native plant invasion into disturbed areas, directed surveys may be conducted in the WUI treatment area. With assistance from the parks' exotic plant program staff, the status of pre-treatment presence of non-native plant species may be determined along with any changes that may occur following initial treatment and after further treatment. Specific protocols have not yet been developed.

Management Implications of Monitoring Results

Recent policy and program initiatives recognize that fire reintroduction is important to fire-maintained landscapes to sustain diverse, functioning ecosystems and to prevent damage from uncharacteristically severe fire that is inevitable with fire exclusion in fire prone areas. Information about the results of fire restoration efforts supplied by the monitoring program is critical feedback needed by land managers, policy-makers, and the public.

The accomplishment of hazard reduction and restoration goals depends upon having a monitoring program that is sufficient to determine whether specific fuel reduction and structural restoration objectives are met. The vegetation and fuels monitoring program results provide the information needed to assess whether specific objectives for the prescribed fire program are met with the level of certainty required. The monitoring program provides a consistent and dependable method of documenting the prescribed fire program's objective achievement. If the objectives are not achieved, managers must determine whether management actions need to be adjusted in order to attain objectives or if the management objectives need to be revised given the current situation. The analysis of some additional data not specifically related to management objectives is used to determine if any unexpected consequences of prescribed fire occur.

Each year, the Fire Ecologist documents the latest vegetation and fuels monitoring program results in an annual report and, unless no new results are available, presents these results to park managers and local scientists for review in an informal meeting setting. This meeting usually takes place in late winter or early spring. At this time, the group discusses current and preliminary results and makes decisions about any changes needed in either the monitoring program or management activities based on these results. Adaptive change(s) should take place if any of the following are apparent from the monitoring results:

- objectives are not sufficiently met
- an undesirable trend is occurring
- an unexpected result occurs
- monitoring methods cannot adequately assess objectives.

Any changes made, such as adjustments to burn prescriptions, changes or additions to monitoring protocols, or modifications of target conditions or management objectives, should be documented at the earliest opportunity in the appropriate section of the Fire and Fuels Management Plan.

FIRE REGIME

One of the primary goals of the parks' fire management program is to restore fire as an ecosystem process across the landscape. As a result, we need to both understand the underlying baseline processes and be able to measure the success of the program's efforts at restoring and maintaining this process.

Fire regime can be defined as the interactions–from simple to complex–of a suite of attributes that constitute how fire operates as a process in a particular vegetation type or specific location. The attributes that describe the characteristics of a fire regime include: fire return interval (distribution, mean, minimum, maximum), season of occurrence, fire size and pattern, fire type (surface, crown, etc.), fire intensity (the quantity of heat produced), and fire severity (level of damage to what is affected by fire).

Important modifiers of these attributes include topographic features such as aspect and elevation, climate, and the lag effects of historic biotic events. Taken together, these attributes define fire as a process in a particular location and setting. Ideally the design of a program to monitor the restoration and maintenance of fire regimes would include the evaluation of all these attributes; however, available information is currently limited by our ability to acquire this knowledge and by the associated costs. Due to its landscape-level scope, fire regime monitoring encompasses all fire management activities occurring throughout all areas of the parks including wildfire and prescribed fire.

Monitoring Goal: Fire regime monitoring provides information to evaluate the cumulative accomplishments of the fire management program in restoring and maintaining the natural fire regime over time across the entire landscape.

Target Conditions

Target conditions for fire return intervals (FRI) and season of fire for each major vegetation type have been determined based on our current knowledge (Table 5). These target conditions represent our best estimate of pre-Euro American settlement fire regimes for these two attributes (FRI and season of fire). Values have been derived from published literature, recent research findings, and local knowledge of park staff.

The range of fire return intervals (minimum to maximum) provides a broad window of possible fire occurrence, while the mean is the arithmetic mean of the fire return interval for the period from 1700 to 1860, the period when fire history reconstructions exist (Caprio and Lineback 1997). R_{max} is the average maximum fire return interval for a given vegetation type (see Caprio and Lineback 1997 for description of calculation) and is a conservative estimate of past fire return interval. Seasonal occurrence of fire under pre-Euro American settlement fire regimes was estimated and divided into categories of summer, early fall, and late fall/early winter seasons. Values are estimates of the percentage of area burned within each of these seasons for each vegetation type.

Table C-4: Target conditions by vegetation type for fire regime attributes (maintenance phase) and estimates of the quality of input information for the target condition values. Rmax is the average maximum fire return interval

Vegetation Type	Fire Return Interval Range	Season of Fire (% of area burned)
Ponderosa Pine- Mixed Conifer	1-15 years (mean = 4, R_{max} = 6) quality – good	0-30% Jun-late Aug 50-70% late Aug-Oct 30-50% Oct-Dec
White Fir-Mixed Conifer	1-30 years (mean = 10, R_{max} = 16) quality – good	0-20% Jun-late Aug 40-60% late Aug-Oct 30-50% Oct-Dec
Giant Sequoia-Mixed Conifer	1-30 years (mean = 10, R_{max} = 16) quality – good	0-20% Jun-late Aug 40-60% late Aug-Oct 30-50% Oct-Dec
Subalpine	50-1,500 years (mean = 187, R_{max} = 508) quality – poor	0-5% Jun-Jul 90-100% Aug-Oct 0-5% Nov-Dec
Xeric Conifer	15-60 years (mean = 30, R_{max} = 50) quality – very poor	0-20% Jun-Jul 50-70% Aug-Sep 10-30% Oct-Dec
Red Fir	9-92 years (mean = 30, R_{max} = 50) quality – poor	0-10% Jun-Jul 80-90% Aug-Oct 0-10% Nov-Dec
Lodgepole Pine	9-300 years (mean = 102, R_{max} = 163) quality – very poor	0-10% Jun-Jul 80-90% Aug-Oct 0-10% Nov-Dec

Vegetation Type	Fire Return Interval Range	Season of Fire (% of area burned)
Mid-Elevation Hardwood	1-23 years (mean = 7, R_{max} = 23) quality – very poor	0-30% Jun-late Aug 50-70% late Aug-Oct 30-50% Oct-Dec
Foothills Hardwood & Grassland	1-17 years (mean = 11, R_{max} = 17) quality – very poor	0-5% May-Jun 30-90% Jul-Oct 0-10% Nov-Dec
Foothill Chaparral	10-100 years (mean = 30, R_{max} = 60) quality – estimated *25% 0-20 yr old stands 50% 20-50 yr old stands 25% >50 yr old stands	0-30% Jun Jul 50-70% Aug Sep 30-50% Oct Dec
Montane Chaparral	?-? years (mean = 30, R_{max} = 75) quality – estimated	unknown
Meadow	?-? years (mean = 40, R_{max} = 65) quality – estimated	unknown

*Note: Area of foothills chaparral vegetation in differing age classes was also defined as an alternative measure due to the difficulty in assigning specific FRI.

Monitoring Objectives

1. Track and evaluate the continued implementation of the restoration of fire into park ecosystems, and

2. Determine whether the continued occurrence (maintenance) of fire over the long term, either from natural or human ignition sources, falls within a target range as determined from specific resource objectives (see Table 4).

Sampling Design

Monitoring fire as a process is a relatively new concept for setting resource objectives in fire management planning. Process monitoring has two requirements: 1) a need to understand historic fire regimes which provide historic reference conditions on past processes, and 2) a method of measuring contemporary fire processes which can be compared against the past processes. The greater the precision of the historic and contemporary information the better the quality of the analysis. In most cases the historic process data is the limiting input. Additionally, historic data are nearly always from a specific interval of time in the past, therefore, longer-term variability must be recognized when interpreting this information for planning purposes. For example, reference conditions may shift as a result of long-term changes in the drivers of fire regimes, such as climate.

Over the last 30-40 years, most fire history information has typically been restricted to solely providing descriptive information on what past fire frequencies were like at particular locations. We can now monitor fire as a process because we have, or can obtain, fairly detailed information about past fire regimes for many vegetation types within the parks, particularly using tree-ring reconstruction methods. This detailed, fairly localized information may be applied to larger landscapes using GIS to extend the use of this information for fire management planning.

Our current sampling objects are to obtain pre-Euro American settlement fire regime information from the array of vegetation types that exist in the parks and to understand how the past fire regime varied across the landscape in differing topographic or biotic settings. When carrying out fire history sampling we will utilize standard field sampling and dendrochronological crossdating methods to provide the highest quality information. In some vegetation types alternative methods may be required.

Field Measurements / Baseline Information

Baseline information used in fire regime monitoring is derived from two sources, 1) a historic reference period, usually for a time period prior to Euro American settlement, and 2) from written records of fire occurrence with associated maps for recent decades. The historic reference information is usually the most limiting. It can be obtained from a variety of sources– anecdotal, cultural, and historic accounts or records (maps and photographs), composition and changes in vegetation assemblages and life history attributes of the particular species in relation to fire, plant community age structure, palynological records, or tree-ring based fire histories. Each comes with differing degrees of precision and length of record. Additionally, all may not provide useful information across all vegetation types or for particular locations on the landscape. Currently, the primary source of high quality historical process data is dendrochronological-based fire history reconstructions that can be obtained in many forested vegetation types. Such data has both explicit spatial and temporal precision to at least the annual level.

At present, knowledge about past fire regimes in the southern Sierra Nevada is generally poor with exceptions for specific vegetation types such as giant sequoia-mixed conifer, white fir-mixed conifer, and ponderosa pine-mixed conifer. A review of fire regime data for the parks suggested that good quality data only exists for vegetation types that cover about 26% of the parks (Caprio and Lineback 1997). Additionally, there is a poor understanding about how specific modifiers, such as aspect and slope, affect the fire regime in differing vegetation types.

Baseline fire regime information is needed for the complete array of vegetation types found in the parks. While some of this information can be derived using dendrochronological analysis of fire scars, in many cases other methods or sources of information will be required. In vegetation types where dendrochronological methods can be used, an unbiased inventory approach with good spatial replication would provide the highest quality data. Sampling would be a one-time process–long-term follow-up sampling is not required once the historic data is acquired. For other vegetation types where dendrochronological methods are not feasible, information about past processes will be much less precise and more difficult to obtain.

Timing of Monitoring

A new FRID map will be produced annually as the time since last fire (TSLF) GIS layer is updated with all new fire perimeters after the end of each fire season. Additionally, when new pre-Euro American fire regime information is obtained that results in updated R_{max} values for specific vegetation types these will be incorporated into the annual FRID calculation.

At five year intervals more detailed analyses of trends in restoring and maintaining fire regimes in the Park's will also be performed. These will compare current trends in area burned to: 1) pre-Euro American trends in area burned annually and 2) change in trends over the last five years or some other time interval (see Caprio and Graber (1999) for details of analyses). Output would be either change in annual area burned or change in area within FRID category over the specified time interval.

Data Analysis

The parks' staff has developed an analysis called Fire Return Interval Departure (FRID) that compares pre-settlement fire regimes to recent regimes (a detailed discussion of the FRID analysis is provided in Chapter 4 of the Fire and Fuels Management Plan). Historic data used in this approach are estimates of fire return intervals (FRI) or maximum average fire return intervals. The FRI input is for a specific interval of time prior to Euro American settlement (1700 to 1860), the period prior to changes in vegetation structure/composition and fuels from grazing, changing ignition sources, and active fire suppression. The output provides maps that rank and highlight areas where fire return intervals have diverged the most from Euro American settlement conditions (Caprio et al. 1997; Keifer et al. 2000). The areas on the FRID map (Figure 4-4) highlighted in red are those locations that have missed the greatest number of projected fire events, and thus are assumed to have the greatest ecological need for fire restoration.

Additional uses of this information are also possible. FRID output can be categorized to highlight locations that have undergone one or more restoration burns and are in need of an additional burn (either restoration of maintenance) due to the elapsed time since the last burn (Keifer et al. 2000). The current fire regime data and FRID analysis have also been used to evaluate the success of the fire management program over the last 30 years (Caprio and Graber 2000). Projections of the historic level of fire occurrence (area burned within each vegetation type) can be estimated from mean FRI. These values can then be compared against actual program achievements to provide feedback to the management program. This feedback can include whether the area burned annually needs to be increased or decreased, or whether different vegetation types need to be emphasized or de-emphasized when carrying out restoration or maintenance burns in locations where the natural role of fire must be restrained.

The season in which each fire burns will also be tracked to determine whether the seasonal aspect of fire regime is maintained in each vegetation type (Table 4).

Information Management

All field collections used to derive fire regime information are archived in the parks or at an approved location. They are primarily composed of partial cross-sections removed from logs, snags, or trees. Collections are currently housed in the Sycamore Lab Shed. All samples are labeled and cataloged in a database located on the fire history computer (office of the Fire Ecologist/Fire Research Coordinator) and backed up offsite. As a potential source of future reference information about fire in park ecosystems, these collections will have long-term value. Eventually, field evidence about past fire regimes will disappear, both because wood decomposes and through the impact of fire.

Specific sample site data and individual sample tree (sample catalog) data are maintained in database format ("**FH_GRP.DBF" and "**FHTREE.DBF" respectively where the '**' refers to a specific area, for example the East Fork of the Kaweah River is 'MK'). Associated site data (elevation, aspect, vegetation composition, fuel load) in the sample tree databases are periodically summarized ("ALL_SEKI_FH_SITES_VEGSUM") and available as either a database file (".DBF") or ArcMap shapefile (".SHP") and an ArcMap project ("FIREHIST_VEG_SUM.MXD").

Quality Control

An important component of the utilization of pre-Euro American fire regime information or fire history reconstructions is an evaluation of the quality of the information going into the estimates. This is especially important because the information has been derived from many sources and from a variety of locations. Some of these locations are at some distance outside the park, which may affect the applicability to park locations.

Caprio and Lineback (1997) reviewed and evaluated the current quality of fire regime information utilized in the parks' current fire regime monitoring methods using FRID. This ranking was based on a variety of criteria and essentially provided an estimate of confidence in the fire regime target condition values (see Table 4). Ranks varied from estimated (vegetation types where FRI values were estimated) to good. However, all estimates had at least some problems. For example, although many sites have reconstructed fire histories in a particular vegetation type, these sites may be limited to only a single aspect (for example, only south-facing slopes), which may limit their applicability across the whole landscape.

Responsible Party

The Fire Ecologist is responsible for providing the most current baseline information used to compare with park fire regime maintenance efforts. The Fire GIS Technician is responsible for annually updating the appropriate GIS layers, in coordination with the Fire Management Office (FMO), and performing the analyses.

Management Implications of Monitoring Results

Recent utilization of fire regime information has had several significant positive effects on the fire management program within the parks. Application of our current knowledge about FRI in specific vegetation types has provided target intervals of when subsequent burns need to be planned. The FRID analysis has resulted in significant changes in burn planning procedures by providing insight into areas that are most in need of having fire restored and in highlighting areas that have been burned previously but which need a second maintenance burn. Additionally, the information has provided an overall evaluation of how well the prescribed fire program is achieving objectives relative to process goals (see Caprio and Graber 2000). Lastly, as the quality and extent of our knowledge about past fire regimes improves, the value of this information to the fire management program will increase.

CULTURAL RESOURCES

All NPS units that implement use of wildland fire and prescribed fire activities must develop short-term and long-term monitoring programs to assess accomplishments and to determine the effects of the associated management activities on park resources, including cultural resources.

As such, monitoring by way of “post-fire” inventories (ground surveys) of burned-over areas is a critical component of the parks’ Fire Management Program. Key direction in designing and applying post-fire inventories is to be found in DO-18 (Fire Management) and DO-28 (Cultural Resource Management).

Monitoring Goal: Cultural resources monitoring provides information needed to determine the effects of fire management activities on cultural resources and to determine the effectiveness of site protection methods. Where feasible, increasing inventories of previously inaccessible areas is an additional goal.

Monitoring Objectives

1. Collect data sufficient to identify the effectiveness of pre-fire cultural resource surveys.

2. Undertake inventories of lands previously inaccessible due to dense brush and vegetation cover.

3. Record new survey results so as to increase the parks’ inventory database, thus providing more comprehensive management and research information.

4. Use inventory results to promote compliance with Section 110 of the National Historic Preservation Act (i.e., direction to inventory all federal lands for the presence/absence of cultural resources and to nominate to the National Register of Historic Places all properties that appear to qualify for listing).

Sampling Design

Cultural Resource Specialists will use their discretion and professional judgment, in consultation with the Fire Management Officer, to select specific acreage and methods for conducting post-fire inventories. Of consideration will be the particular features of the burned area or unit in question and the management benefit to cultural resources. In general, stratified, random surveys will be employed to maximize field efforts, with a goal of examining a minimum of 20 percent of pre-fire vegetated areas. Post-fire inventories may be designed to address any combination of the following focuses:

- Previously inventoried acreage within a prescribed fire unit or wildland fire area as a cross-reference on the efficacy of the pre-fire methods and results.
- Previously un-inventoried acreage within a prescribed fire unit or wildland fire area.
- Sampling within identifiable vegetation zones or biotic communities to expand basic knowledge on site patterning and modeling.
- Selective inventory of areas or features suspected to contain cultural resources but for which little or no data are available.

Field Measurements

Standard levels of recordation will be made for all post-fire inventories, including acres surveyed, survey intensity, and estimates of ground-surface visibility. Site forms (including maps, photographs, and illustrations) will be prepared for each newly recorded site/structure/feature. Isolated Find forms will be completed as appropriate. Updates to previously recorded sites will be completed as justified, with an emphasis on identifying newly exposed surface artifacts or features, expanded site dimensions, any apparent fire effects, and the like.

Timing of Monitoring

Post-fire survey should be undertaken within 60 days of the fire episode. Scheduling should consider the season (e.g., are rains imminent?), with an emphasis on targeting periods when ground visibility is maximized (e.g., before vegetation re-growth obscures ground surface visibility, or, after the first post-fire rain or wind episode sufficient to expose mineral soils).

Monitoring Site Location/Relocation

Cultural Resources Specialists, in consultation with the Fire Management Officer, will identify the location and limits of post-fire surveys. Knowledge of site patterning will be weighed against the effectiveness of the fire episode in exposing ground surfaces. Slopes in excess of 30 percent will generally not be included in the sample, unless specific conditions argue for their inclusion (e.g., caves and rock shelters exposed by the fire). Such areas excluded from examination will not be used in calculating a 20 percent sample universe. Monitoring site locations will be plotted on field maps as part of the pre-field planning. GIS, GPS, and UTM data will be compared to assure the accurate placement of the monitoring sites and to assure that the selected sites are visited in the field.

Data Analysis

Post-fire data stand to enhance the parks' ability to better predict the potential impacts of a fire episode, whether during the planning stages of future prescribed fires or in response to a wildland fire. A report of results will be prepared for each post-fire cultural resource inventory. Minimally, such reports will be shared with the State Historic Preservation Officer, the Park Superintendent, and the Fire Management Officer.

Data Sheet Example

Results will be recorded on standard site forms, including Primary Records, Isolated Find forms, and attachments, as needed (DPR 523; State Historic Preservation Office 1990).

Information Management

Reporting requirements for cultural resource inventory projects can be found in NPS-28. Further, key confidentiality rules apply to archeological and ethnographic resource information as identified in DO-28.

Quality Control

Field personnel and principal investigators will meet the qualification standards found in Appendix E of NPS-28.

Responsible Party

The parks' Cultural Resources Specialist is responsible for coordinating the design, implementation, and reporting of any post-fire inventory project. This individual will work closely with the parks' Fire Management Officer in meeting this requirement.

Funding

All expenditures (personnel, aircraft, equipment and supplies) for monitoring fire effects or the effectiveness of pre-fire protection treatments on cultural resources that are not covered by existing base accounts will be charged to the appropriate fire account. All expenditures will be tracked and reported according to the standards established in the Department of the Interior Individual Fire Occurrence Form (DOI-1202). All fires will have an appropriate fire management accounting code (suppression, prescribed or fire use). Funding for post-fire inventories in previously unsurveyed areas will be sought on an annual basis from a number of sources.

Management Implications of Monitoring Results

Data recovered from the result of post-fire inventories stand to better inform future decisions when planning for prescribed fires or when responding to wildland fires. Increasing the intensity or focus of future inventories may result. Conversely, post-fire inventory data may prove useful in identifying areas or situations where the intensity or focus of cultural resource investigations can be lessened. Monitoring results should serve to increase the parks' effectiveness in meeting its responsibilities for the management of significant cultural resources.

FIRE MONITORING PROGRAM INTEGRATION

The above components of Sequoia and Kings Canyon National Parks' fire monitoring program were developed at different times in response to evolving fire management information needs. In addition, levels of funding for monitoring have varied throughout the program's history. As a result of differences in timing and levels of effort, the components are not as well integrated as they could be and vary in their scale of applicability.

The monitoring program began with environmental and fire conditions, and vegetation and fuels. These components provide information to guide fire management strategies and to assess project and stand-level objectives. Later, the parks' program took a step forward in the direction of large-scale restoration by embarking upon a project to test the feasibility of landscape-scale prescribed fire through treatment of an entire watershed within a relatively short period of time. With potential new issues arising from this larger-scale approach, the wildlife and water components were designed specifically to provide additional information for this watershed project.

While some of these monitoring efforts were focused in the East Fork Kaweah watershed, similar monitoring may be needed in other watersheds to determine whether results are more widely applicable throughout the parks. If this expansion occurs, the monitoring sites should be co-located with existing monitoring sites wherever possible to take advantage of the information provided by ongoing monitoring. Co-locating future monitoring with existing sites will provide more comprehensive information for those sites and result in a more integrated monitoring program.

In addition to a spatial expansion of the program, after several decades of an active prescribed fire program, restoration objectives were achieved in some areas and the need to define new, longer-term objectives arose. Those objectives relating to maintaining the natural fire regime are applied both in areas where restoration is achieved and also areas that had not been greatly altered by fire exclusion. These new objectives focus on maintaining aspects of the fire regime that will perpetuate natural ecosystem processes, which in turn will influence future ecosystem component structure (e.g. fuel quantity and arrangement, wildlife habitat, vegetation composition, etc.). Refining the maintenance objectives and developing good measures for these objectives is the focus of the next phase of the fire monitoring program. New objectives will also need to be developed that address climate change projections as they become better refined.

Since the development of the parks' fire monitoring program, the National Park Service has initiated a nationwide program to inventory and monitor natural resources (known as the Inventory and Monitoring, or I&M, Program) in parks grouped into 'networks' by eco-regions. Sequoia and Kings Canyon National Parks, is part of the Sierra Nevada Network, along with Yosemite National Park and Devils Postpile National Monument. The Sierra Nevada Network (SNN) has received I & M funding, has implemented inventory projects, and planning is underway for the development of a, long-term monitoring program for a few key ecosystem components.

Key to the success of the fire monitoring program is continuing to maintain close ties with the SNN I&M program and with the research community. Results from the I&M program, as well as results from research conducted by the USGS Biological Resources Division, will provide additional useful information. This information, may offer excellent comparative capabilities, especially in areas where naturally-ignited and suppression fires occur, as well as areas where fire has been excluded for unusually long periods, making inferences from the monitoring results more powerful.

To ensure useful comparative analyses are possible, integration with the existing fire monitoring program is critical during the planning and implementation stages of the I&M program to ensure that the necessary information is collected in a useful and compatible way. The parks' fire monitoring program staff has been involved in scoping sessions to determine which of the parks' natural resource elements are most in need of long-term monitoring. Continued collaboration between the I&M and fire monitoring programs will help insure the most efficient use of both programs' funds and efforts, and provide for a more comprehensive and integrated long-term program to monitor the status of the parks' resources.

The various monitoring program staff should work together to take advantage of shared efforts where possible, reduce redundancy, and focus efforts on the highest priorities to provide the parks with the most efficient natural resource monitoring program. Continually identifying new information needs is essential to making sure that the parks are meeting fire-related resource goals as the fire management program evolves. Also, in response to new management objectives, the appropriate monitoring techniques must be developed and implemented.

REFERENCES

Caprio, A. C. and P. Lineback. 1997. Pre-twentieth century fire history of Sequoia and Kings Canyon National Parks: A review and evaluation of our knowledge. In: Proceedings of the Conference on Fire in California Ecosystems: Integrating Ecology, Prevention, and Management. Nov. 17-20, 1997, San Diego, CA.

Caprio, A. C., C. Conover, M. Keifer, and P. Lineback. 1997. Fire management and GIS: A framework for identifying and prioritizing fire planning needs. In: Proceedings of the Conference on Fire in California Ecosystems: Integrating Ecology, Prevention, and Management. Nov. 17-20, 1997, San Diego, CA.

Keeley, J. E. and N. L. Stephensen. 2000. Restoring natural fire regimes to the Sierra Nevada in an era of global change. Pages 255-265 in Cole, D. N., and S. F. McCool, compilers. Wilderness Science in a Time of Change conference – Volume 5: Wilderness ecosystems, threats, and management; 1999 May 23-27 Missoula MT. Proceedings RMRS-P-15-Vol-5. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Keifer, M., A.C. Caprio, P. Lineback, and K. Folger. 2000. Incorporating a GIS model of ecological need into fire management planning. In: Proceedings of the Joint Fire Science Conference and Workshop, Crossing the Millennium: Integrating Spatial Technologies and Ecological Principles for a New Age in Fire Management, June 14-16, 1999, Boise, ID.

Keifer, M., N. L. Stephenson and J. Manley. 2000. Prescribed fire as the minimum tool for wilderness forest and fire restoration: a case study from the Sierra Nevada. In: Cole, David N.; McCool, Stephen F. Proceedings: Wilderness Science in a Time of Change. Proc. RMRS-P-15. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Miller, C. and D.L. Urban. 1999. A model of surface fire, climate, and forest pattern in the Sierra Nevada, California. Ecological Modeling 114:113-135.

National Park Service, U.S. Department of Interior. 2003. Fire Monitoring Handbook. National Interagency Fire Center, Boise, ID. 274 pp. http://www.nps.gov/fire/fmh/FEMHandbook.pdf.

National Park Service, U.S. Department of Interior. 1971. Sequoia and Kings Canyon National Parks Master Plan. Sequoia and Kings Canyon National Parks, Three Rivers, CA.

National Park Service. 1999. Natural and Cultural Resource Management Plan. Sequoia and Kings Canyon National Parks, Three Rivers, CA.

State Historic Preservation Office. 1990. Instructions for Completing the California Historic Resources Inventory Form (DPR 523). Sacramento, CA.

REVIEWERS

This plan was prepared by MaryBeth Keifer, Tony Caprio, Harold Werner, Corky Conover, and Tom Burge. The monitoring plan will be reviewed on an annual basis and revised if necessary.

This plan was reviewed by:

Bill Kaage, Fire Management Officer, Date
Sequoia and Kings Canyon National Parks

John Austin, Acting Chief, Division of Natural Resources, Date
Sequoia and Kings Canyon National Parks

Jeff Manley, Natural Resource Management Specialist, Date
Sequoia and Kings Canyon National Parks

Dave Graber, Science Advisor, Date
Sequoia and Kings Canyon National Parks

Paul Reeberg, Fire Effects Program Manager, Date
NPS Pacific West Regional Office

Robin Wills, Fire Ecologist, Date
NPS Pacific West Regional Office

ATTACHMENTS

Table C-5: Monitoring forms available

Monitoring Program Component	Forms	Location of Forms
Environmental and fire conditions	Weather observation Fire behavior observation Smoke observation Fuel moisture summary Monitoring report outline Wildland fire observation summary	FMH, Appendix A (NPS 2001)
Vegetation and fuels	Park Monitoring Type Descriptions (FMH-4) modified FMH data sheets Field Data Checklist Quality Check Log	FMH, Appendix A (NPS 2001) SEKI LAN, j:\data\plants\fire_effects\vegetation_fuels_fmh\products\forms
Additional fuels information for modeling	Fuel data Stand data	SEKI LAN, j:\data\fire\fuels\gis
Wildlife	Plot data Serendipity data	SEKI LAN, j:\data\animals\vertebrates\wildlife_fire_effects\products

Monitoring Type Protocols FMH Data - SEKI Page: 0001

FMH version 3.10, Printed on 02/27/03, 5:58:14 pm

Current directory: C:\Program Files\Microsoft SQL Server\MSSQL.1\MSSQL\Data

---------------------------------Description----------------------------------

Monitoring Type Code: FABCO1T08 Date Described: 06/15/00

Monitoring Type Name: White Fir-Mixed Conifer Forest

Preparer: M. Keifer, G. Dempsey (Updated T. Caprio 2012)

FGDC Association:

FMH-4 Version Title/Description: White fir-mixed conifer forest

Visits Assigned: 00 PR01, 00 PRE, 00 yr01, 00 yr02 (abandoned 2012),, 00 yr04, 00 yr05, 00 yr10, 00 yr18, 00 yr20, 01 Post,01 yr01, 01 yr02 (abandoned 2012),, 01 yr05, 01 yr10, 01 yr20, 01 yr30, 02 Pre, 02 Post, 02 yr01, 02 yr02 (abandoned 2012), 02 yr05, 02 yr10, 03 Pre, 03 Post, 03 yr01, 03 yr02 (abandoned 2012), 03 yr05, 03 yr10, 04 Pre

Burn Prescription

Date of Burn (mo-mo)......08-01,11-30 Aspect (deg.).............000-000

Wind Direction (deg.)..... Spread Direction (B/H/F).H

Fuel (tns/ac)...........20.0-80.0 Herb Moisture (%).......0-0

Live Woody (tns/ac).....0.0-0.0 Midflame Wind (mph).....0.0-10.0

Herbs (tns/ac)..........0.0-0.0 Rate of Spread (ch/hr)..0.0-8.0

Air Temp. (F)...........40-85 Heat per Area (btu/ftý).165.0-225.0

Rel. Humidity (%).......20-60 Fireline Intns (btu/ftý)1.0-35.0

1-hr TLFM (%)...........3-10 Slope (%)...............0-60

10-hr TLFM (%)..........11 Flame Length (ft).......0.0-2.5

100-hr TLFM (%).........12 Flame Zone Depth (ft)...0.0-0.0

1000-hr TLFM (%)........20 Scorch Height (m).......0.0-30.0

Woody Moisture (%)......0-0 Char Height (m).........0.0-0.0

Additional Prescription Information: Tons per acre were estimated.

Management Objectives: Reduce the total fuel load by 60-95% immediately postburn.

Monitoring Objectives: Measure the mean total fuel load with a sample size which will allow us to be 80% confident that our results are within 25% of the true population mean.

Objective Variables: Total fuel load (tons/acre); white fir overstory density

Physical Description: Predominately north and west aspects, though others may apply. Slopes range from 20-60% and are generally mid to upper slope.

Elevation ranges from 4,100 - 7,200 feet. Soil depth ranges from shallow to very deep. Soils are generally rather coarse textured and acidic.

Biological Description: Of the total number of white firs (Abies concolor)present, roughly 25% or greater are mature overstory trees (>40cm at DBH). Sugar pine (Pinus lambertiana) and incense cedar (Calocedrus decurrens) will occur in varying amounts. At the higher elevations, associates may also include Jeffrey pine (Pinus jeffreyi) along w/ red fir (Abies magnifica).

Overstory maturity rating is in the medium to high categories. Understory is usually comprised of incense cedar and white fir. There is a distinct absence of oaks of all species, and ponderosa pines (P. ponderosa) are rarely seen within the general vicinity. Total number of live trees within the 20m by 50m area will most likely range between 20 and 100 trees. Numerous trees fall into the intermediate and suppressed categories. The forest floor is typically sparse, with few herbs. Shrubs such as chinquapin (Chrysolepis sempervirens), hazelnut (Corylus cornuta), or Ribes sp. contribute <20% cover.

Rejection Criteria: Exclude riparian zones, anomalous vegetation patches, monitoring type boundaries, large rock outcroppings or barren areas (>20% of the plot), or areas within 20 meters of physical barriers such as roads or within 5 meters from any trail. Exclude areas where >25% of the overstory trees have been severely damaged by insects such as tussock moths.

Notes (This Entire Monitoring Type): See the notes listed under the FSEGI monitoring type for critical information.

-------------------------------General Protocols--------------------------------

Comments (Deviations, Problems, Omissions), this Version Only: (No information provided)

Preburn Control Plots..............No Herb. Height...............Yes

Herbaceous Density.........No Abbreviated Tags...........Yes

0P/Origin Buried...........No Herbaceous Fuel Load.......No

Voucher Specimens..........Yes Brush Fuel Load............No

Count Dead Branches of Living Plants as Dead.................No

Width "Observed" Transect..10.0m

Herb Transects Sampled.....Q4-Q1 Q3-Q2

Shrub Transects Sampled....Q4-Q1 Q3-Q2

Length One Shrub Transect..50m   Width One Shrub Transect...2.0m

Total Shrub Area...........200.0m2

Stakes Installed At........All 17

Burn and Duff Moisture..............Yes   Flame Zone Depth...........No

Postburn 100 Points Burn Severity...No   Herbaceous Fuel Load.......No

Herb. (FMH-15/17/21).......Yes

-----------------------------Forest Plot Protocols------------------------------

Overstory Live Tree Damage...........Yes   Live Crown Position.........Yes

Dead Tree Damage...........No   Dead Crown Position.........Yes

Record DBH Year 1..........Yes

Total Length Sample Area...100.0m Total Width Sample Area.....10.0m

Total Sample Area..........1000.00m2

Quarters Sampled...........1 2 3 4

Minimum allowed DBH........0.1cm   Maximum allowed DBH.........999.9cm

Pole-size Live Height................Yes   Poles Tagged................Yes

Dead Height................Yes   Record DBH Year 1...........Yes

Total Length Sample Area...25.0m   Total Width Sample Area.....10.0m

Total Sample Area..........250.00m2

Quarters Sampled...........1

Minimum allowed DBH........2.5cm   Maximum allowed DBH.........15.0cm

Seedling Live Height................Yes   Seedlings Mapped............Yes

Dead Height................Yes   Dead Seedlings..............Yes

Total Length Sample Area...10.0m   Total Width Sample Area.....5.0m

Total Sample Area..........50.00m2

Subsample of Quarter.......1

Fuel Load Number of Sampling Planes..4   1 HR Plane Length...........6ft

10 HR Plane Length.........6ft   100 HR Plane Length.........12ft

1000 HR Sound Plane Length.50ft   1000 HR Rotten Plane Length.50ft

Calculate Dominance........Yes

Postburn Overstory Char Height......Yes

Pole-sized Postburn AssessmYes   Pole-sized Char Height......Yes

Severity Transects Sampled.Fuel

FMH version 3.10, Printed on 02/27/03, 5:57:47 pm

Current directory: C:\Program Files\Microsoft SQL Server\MSSQL.1\MSSQL\Data

---------------------------------Description----------------------------------

Monitoring Type Code: FABMA1T08 Date Described: 06/15/00

Monitoring Type Name: Red Fir Forest

Preparer: Keifer/Dempsey (Updated T. Caprio 2012)

FGDC Association:

FMH-4 Version Title/Description: Red fir forest

Visits Assigned: 00 PRE, 00 yr01, 00 yr02 (abandoned 2012), 00 yr05, 00 yr10, 01 Post, 01 yr01, 01 yr02 (abandoned 2012), 01 yr05, 01 yr10, 02 Post, 02 yr02 (abandoned 2012)

Burn Prescription

Date of Burn (mo-mo)......08-01,11-30 Aspect (deg.).............0-90

Wind Direction (deg.)..... Spread Direction (B/H/F)..H

Fuel (tns/ac)...........10.0-60.0 Herb Moisture (%).......0-0

Live Woody (tns/ac).....0.0-0.0 Midflame Wind (mph).....0.0-10.0

Herbs (tns/ac)..........0.0-0.0 Rate of Spread (ch/hr)..0.0-8.0

Air Temp. (F)...........40-85 Heat per Area (btu/ftý).165.0-225.0

Rel. Humidity (%).......20-60 Fireline Intns (btu/ftý)1.0-35.0

1-hr TLFM (%)...........3-10 Slope (%)...............0-60

10-hr TLFM (%)..........11 Flame Length (ft).......0.0-2.5

100-hr TLFM (%).........12 Flame Zone Depth (ft)...0.0-0.0

1000-hr TLFM (%)........20 Scorch Height (m).......0.0-30.0

Woody Moisture (%)......0-0 Char Height (m).........0.0-0.0

Additional Prescription Information: (No information provided)

Management Objectives: Reduce the total fuel load by 60-95% immediately postburn.

Monitoring Objectives: Measure the mean total fuel load with a sample size which will allow us to be 80% confident that our results are within 25% of the true population mean.

Objective Variables: Total fuel load (tons/acre); red fir overstory density.

Physical Description: Aspect is most commonly east and north slopes for pure stands of red fir. Slope varies from 0-60% and elevation ranges from 7,000 -

9,500 ft. Soils are often deep sandy loams associated with unglaciated areas, as well as shallower soils.

Biological Description: Overstory consists primarily of red fir (Abies magnifica), (>40% of the total of all trees present). At its lower limit, red fir is mixed with Jeffrey and sugar pine (Pinus jeffreyi and P. lambertiana) and incense cedar (Calocedrus decurrens). White fir (Abies concolor) individuals may also be present. Where white firs are more common, at least 80% of this species will be <40 cm at DBH, thus leaving the dominance of the stand to the red fir. Western white pine (Pinus monticola), lodgepole pine (Pinus contorta), montane brush and meadows are associated with red fir at its upper limit.

Common understory vegetation includes manzanita (Arctostaphylos spp.), buckbrush

(Ceanothus spp.), gooseberry (Ribes spp.) and chinquapin (Chrysolepsis sempervirens), however, keep in mind that the forest floor is generally much more open than in the lower elevation mixed conifer forests. Few herbaceous plants are present, especially at higher elevations.

Rejection Criteria: Exclude riparian zones, anomalous vegetation patches, monitoring type boundaries, large rock outcroppings or barren areas (>20% of the plot), or areas within 20 meters of physical barriers such as roads or within 5 meters from any trail.

Notes (This Entire Monitoring Type): Read all notes under the FSEGI monitoring type. (No old style plots apply for the FABMA monitoring type, however.)

-------------------------------General Protocols--------------------------------

Comments (Deviations, Problems, Omissions), this Version Only: See all notes under the FSEGI monitoring type.

Preburn Control Plots.............Yes Herb. Height...............Yes

Herbaceous Density.........No Abbreviated Tags...........Yes

0P/Origin Buried...........No Herbaceous Fuel Load.......No

Voucher Specimens..........Yes Brush Fuel Load............No
Count Dead Branches of Living Plants as Dead.................No

Width "Observed" Transect..10.0m

Herb Transects Sampled.....Q4-Q1 Q3-Q2

Shrub Transects Sampled....Q4-Q1 Q3-Q2

Length One Shrub Transect..50m Width One Shrub Transect...1.0m

Total Shrub Area...........100.0m2

Stakes Installed At........17

Burn and Duff Moisture..............Yes Flame Zone Depth...........No

Postburn 100 Points Burn Severity...No Herbaceous Fuel Load.......No

Herb. (FMH-15/17/21).......Yes

-----------------------------Forest Plot Protocols------------------------------

Overstory Live Tree Damage...........Yes Live Crown Position.........Yes

Dead Tree Damage...........Yes Dead Crown Position.........Yes

Record DBH Year 1..........Yes

Total Length Sample Area...50.0m Total Width Sample Area.....20.0m

Total Sample Area..........1000.00m2

Quarters Sampled...........1 2 3 4

Minimum allowed DBH........0.0cm Maximum allowed DBH.........999.9cm

Pole-size Live Height................No Poles Tagged................No

Dead Height................No Record DBH Year 1...........Yes

Total Length Sample Area...0.0m Total Width Sample Area.....0.0m

Total Sample Area..........0.00m2

Quarters Sampled...........1

Minimum allowed DBH........0.0cm Maximum allowed DBH.........0.0cm

Seedling Live Height................Yes Seedlings Mapped............Yes

Dead Height................Yes Dead Seedlings..............Yes

Total Length Sample Area...25.0m Total Width Sample Area.....10.0m

Total Sample Area..........250.00m2

Quarters Sampled...........1

Fuel Load Number of Sampling Planes..4 1 HR Plane Length...........6ft

10 HR Plane Length.........6ft 100 HR Plane Length.........12ft

1000 HR Sound Plane Length.50ft 1000 HR Rotten Plane Length.50ft

Calculate Dominance........Yes

Postburn Overstory Char Height......Yes

Pole-sized Postburn AssessmNo Pole-sized Char Height......No

Severity Transects Sampled.Fuel

----------------------------------Description-----------------------------------

Monitoring Type Code: BADFA1D04 Date Described: 08/17/00

Monitoring Type Name: Chamise Chaparral

Preparer: Keifer/Dempsey (Updated T. Caprio 2012)

FGDC Association:

FMH-4 Version Title/Description: Chamise chaparral

Visits Assigned: 00 PRE, 01 Post, 01 yr01, 01 yr02(abandoned 2012), yr10, 02 Post

Burn Prescription

Date of Burn (mo-mo)......09-01,02-15 Aspect (deg.).............140-270

Wind Direction (deg.)..... Spread Direction (B/H/F)..H

Fuel (tns/ac)...........0.0-0.0 Herb Moisture (%).......50-150

Live Woody (tns/ac).....0.0-0.0 Midflame Wind (mph).....0.0-8.0

Herbs (tns/ac)..........0.0-0.0 Rate of Spread (ch/hr)..2.0-120.0

Air Temp. (F)...........33-85 Heat per Area (btu/ftý).1570.0-2910.0

Rel. Humidity (%).......20-60 Fireline Intns (btu/ftý)50.0-6330.0

1-hr TLFM (%)...........5-9 Slope (%)...............0-60

10-hr TLFM (%)..........10 Flame Length (ft).......3.0-25.0

100-hr TLFM (%).........11 Flame Zone Depth (ft)...0.0-0.0

1000-hr TLFM (%)........0 Scorch Height (m).......0.0-0.0

Woody Moisture (%)......0-0 Char Height (m).........0.0-0.0

Additional Prescription Information: (No information provided)

Management Objectives: Currently there are no specific objectives for this monitoring type. Generally speaking, the goal is to reduce hazardous amounts of fuel by lessening the % of cover of chaparral brush species while reintroducing fire to its natural role in the community.

Monitoring Objectives: % Cover of Brush.

Objective Variables: Measure the % cover of brush species with a sample size which will allow us to be 80% confident that our results are within 25% of the true population mean.

Physical Description: Generally found below 4,000 feet in elevation, on south and west facing slopes. Little soil is present on the dry, rocky, often steep slopes. May be interspersed with mixed chaparral and oak woodland forest.

Biological Description: Chaparral dominated by chamise (Adenostoma fasciculatum) 1-3m in height. Associated species contribute very little to cover. Mature stands are quite homogenous and are densely interwoven thus allowing very little opportunity for herbaceous plants to become established.

Rejection Criteria: Exclude riparian zones, anomalous vegetation patches, monitoring type boundaries, large rock outcroppings or barren areas (>20% of the plot), or areas within 20 meters of physical barriers such as roads or within 5 meters from any trail. Exclude areas >1/4 km from the roadway due to safety concerns and slopes over 60%.

Notes (This Entire Monitoring Type): (No information provided)

-------------------------------General Protocols--------------------------------

Comments (Deviations, Problems, Omissions), this Version Only: (No information

provided)

Preburn Control Plots..............No Herb. Height...............Yes

Herbaceous Density.........No Abbreviated Tags...........Yes

0P/Origin Buried...........No Herbaceous Fuel Load.......No

Voucher Specimens..........Yes Brush Fuel Load............No

Count Dead Branches of Living Plants as Dead.................No

Width "Observed" Transect..0.0m

Herb Transects Sampled.....0P-30P

Length One Shrub Transect..30m Width One Shrub Transect...2.0m

Total Shrub Area...........60.0m2

Stakes Installed At........2

Burn and Duff Moisture.............No Flame Zone Depth...........No

Postburn 100 Points Burn Severity...Yes Herbaceous Fuel Load.......No

Herb. (FMH-15/17/21).......Yes

Monitoring Type Protocols FMH Data - SEKI Page: 0001

FMH version 3.10, Printed on 02/27/03, 5:59:10 pm

Current directory: C:\Program Files\Microsoft SQL Server\MSSQL.1\MSSQL\Data

----------------------------------Description-----------------------------------

Monitoring Type Code: BARME1D04 Date Described: 08/17/00

Monitoring Type Name: Mixed Chaparral

Preparer: Keifer, Dempsey (Updated T. Caprio 2012)

FGDC Association:

FMH-4 Version Title/Description: Mixed chaparral

Visits Assigned: 00 PR01, 00 PRE, 01 Post, 01 yr01, 01 yr02 (abandoned 2012), 01 yr05, yr10

Burn Prescription

Date of Burn (mo-mo)......09-01,02-15 Aspect (deg.).............

Wind Direction (deg.)..... Spread Direction (B/H/F)..H

Fuel (tns/ac)...........0.0-0.0 Herb Moisture (%).......50-150

Live Woody (tns/ac).....0.0-0.0 Midflame Wind (mph).....0.0-8.0

Herbs (tns/ac)..........0.0-0.0 Rate of Spread (ch/hr)..2.0-120.0

Air Temp. (F)...........33-85 Heat per Area (btu/ftý).1570.0-2910.0

Rel. Humidity (%).......20-60 Fireline Intns (btu/ftý)50.0-6330.0

1-hr TLFM (%)...........5-9 Slope (%)...............0-60

10-hr TLFM (%)..........10 Flame Length (ft).......3.0-25.0

100-hr TLFM (%).........11 Flame Zone Depth (ft)...0.0-0.0

1000-hr TLFM (%)........0 Scorch Height (m).......0.0-0.0

Woody Moisture (%)......0-0 Char Height (m).........0.0-0.0

Additional Prescription Information: (No information provided)

Management Objectives: No objective has been identified at this time. Our current goal is to reduce brush cover by restoring fire.

Monitoring Objectives: Measure the % cover of brush species with a sample size which will allow us to be 80% confident that our results are within 25% of the true population mean.

Objective Variables: % cover of brush species

Physical Description: Found below 5,000 feet on dry, rocky slopes with little soil. Slopes range from 0-60% and may be fund within a variety of aspects.

Substrate is commonly rocky and dry.

Biological Description: Drought tolerant, sclerophyllous shrubs, 2-4m in height form dense, often impenetrable walls of vegetation which are dominated by mountain whitethorn (Ceanothus cuneatus), Fremontia (Fremontodendron californicum), manzanita (Arctostaphylos kelloggii) and mountain mahogany (Cercocarpus betuloides). Other understory brush associates may include varying amounts of buckeye (Aesculus californica), coffeeberry (Rhamnus spp.) and poisonoak (Toxicodendron diversilobum). Herbaceous plants (Bromus spp., Avena spp.,Vulpia spp., Cryptantha spp., Phacelia spp., Claytonia spp., and Galium spp.)can be uncommon, with diversity increasing during the first few years following fire. Where herbaceous cover is sparse, a layer of leaf litter may have accumulated.

Rejection Criteria: Exclude riparian zones, anomalous vegetation patches, monitoring type boundaries, large rock outcroppings or barren areas (>20% of the plot), or areas within 20m of physical barriers such as roads or w/in 5 m from any trail. Exclude areas >1/4 km from the road, due to safety concerns as wells slopes over 60%.

Notes (This Entire Monitoring Type): Notes: % cover is picked up from the OP-30P line. It has been determined that density of individual brush species will not be sampled as it does not relate to any current objectives and poses sampling difficulties. Additional plants are examined (and recorded) in a 5m wide belt along either side of the OP-30P line.

Small tree like shrubs (examples: manzanita, buckbrush, Quercus kelloggii and Fremontia) are found within some of these plots. Because they are growing more like shrubs than trees, we are recording their height to the nearest decimeter even if they go past 2.0 meters.

-------------------------------General Protocols--------------------------------

Comments (Deviations, Problems, Omissions), this Version Only: (No information

provided)

Preburn Control Plots.............No Herb. Height...............Yes

Herbaceous Density.........No Abbreviated Tags...........Yes

0P/Origin Buried...........No Herbaceous Fuel Load.......No

Voucher Specimens..........Yes Brush Fuel Load............No

Count Dead Branches of Living Plants as Dead.................No

Width "Observed" Transect..0.0m

Herb Transects Sampled.....0P-30P

Length One Shrub Transect..30m   Width One Shrub Transect...1.0m

Total Shrub Area...........30.0m2

Stakes Installed At........2

Burn and Duff Moisture..............No   Flame Zone Depth...........No

Postburn 100 Points Burn Severity...No   Herbaceous Fuel Load.......No

Herb. (FMH-15/17/21).......No

Monitoring Type Protocols FMH Data - SEKI Page: 0001

FMH version 3.10, Printed on 02/27/03, 5:57:22 pm

Current directory: C:\Program Files\Microsoft SQL Server\MSSQL.1\MSSQL\Data

----------------------------------Description-----------------------------------

Monitoring Type Code: FCADE1T09 Date Described: 06/15/00

Monitoring Type Name: Low Elevation-Mixed Conifer

Preparer: Keifer and Dempsey (Updated T. Caprio 2012)

FGDC Association:

FMH-4 Version Title/Description: Low elevation-mixed conifer forest

Visits Assigned: 00 PR01, 00 PR02, 00 PRE, 00 yr01, 00 yr02 (abandoned 2012), 01 Pre, 01 Post, 01 yr01, 01 yr02 (abandoned 2012), 01 yr05, 01 yr10, 02 Pre, 02 Post, 02 yr01, 02 yr02 (abandoned 2012), 02 yr05, 02 yr10

Burn Prescription

Date of Burn (mo-mo)......07-15,11-30 Aspect (deg.).............180-270

Wind Direction (deg.)..... Spread Direction (B/H/F)..H

Fuel (tns/ac)...........10.0-60.0 Herb Moisture (%).......0-0

Live Woody (tns/ac).....0.0-0.0 Midflame Wind (mph).....0.0-8.0

Herbs (tns/ac)..........0.0-0.0 Rate of Spread (ch/hr)..1.0-18.0

Air Temp. (F)...........40-85 Heat per Area (btu/ftý).320.0-390.0

Rel. Humidity (%).......20-60 Fireline Intns (btu/ftý)4.0-120.0

1-hr TLFM (%)...........5-7 Slope (%)...............0-45

10-hr TLFM (%)..........8 Flame Length (ft).......1.0-4.0

100-hr TLFM (%).........9 Flame Zone Depth (ft)...0.0-0.0

1000-hr TLFM (%)........20 Scorch Height (m).......0.0-30.0

Woody Moisture (%)......0-0 Char Height (m).........0.0-0.0

Additional Prescription Information: (No information provided)

Management Objectives: Reduce the total fuel load by 60-95% immediately postburn.

Monitoring Objectives: Measure the mean total fuel load with a sample size which will allow us to be 80% confident that our results are within 25% of the true population mean.

Objective Variables: Total fuel load (tons/acre); incense cedar overstory density

Physical Description: Aspect is south or west but can vary widely. Slopes range from 0-60%, and are mid to lower slope. Elevation begins at 4,500 ft and extends to 6,000 ft. Soils are often but now always thin, and barren rock outcrops are common.

Biological Description: Overstory consists of incense cedar (Calocedrus decurrens), often near 1/3 of the area, along with varying amounts of sugar pine Pinus lambertiana), black oak (Quercus kelloggii) and canyon live oak (Q. chrysolepsis). Ponderosa pine does not comprise more than 15% of the overstory, and Jeffrey pine individuals are rarely found in the general area. Mature white fir (>40 cm dbh) comprise less than 10% of the overstory. Overstory maturity rating is in the low to medium range, with many trees falling into the intermediate and suppressed categories. Understory is usually comprised of incense cedar, various oaks and white fir. Total number of live trees usually ranges between 60 and 200 per 20m by 50m area, making these forests typically more dense than those found within the FABCO monitoring type. Shrubs such as manzanita (Arctostaphylos spp.), buckbrush (Ceanothus spp.), gooseberry (Ribes spp.), Rubus spp., Prunus spp., or bear clover (Chamaebatia foliolosa) compose a larger portion of the understory than in higher elevation forests. Herbs are sparse to moderately common.

Rejection Criteria: Exclude riparian zones, anomalous vegetation patches, monitoring type boundaries, large rock outcroppings or barren areas (>20% of the plot), or areas within 20 meters of physical barriers such as roads or within 5 meters from any trail. Exclude areas where >25% of the overstory trees have been severely damaged by insects such as tussock moths.

Notes (This Entire Monitoring Type): Read all notes under the FSEGI monitoring type for all deviations from the FMH protocol.

-------------------------------General Protocols--------------------------------

Comments (Deviations, Problems, Omissions), this Version Only: (No information

provided)

Preburn Control Plots.............Yes Herb. Height...............Yes

Herbaceous Density.........No Abbreviated Tags...........Yes

0P/Origin Buried...........No Herbaceous Fuel Load.......No

Voucher Specimens..........Yes Brush Fuel Load............No

Count Dead Branches of Living Plants as Dead.................No

Width "Observed" Transect..10.0m

Herb Transects Sampled.....Q4-Q1 Q3-Q2

Shrub Transects Sampled....Q4-Q1 Q3-Q2

Length One Shrub Transect..50m   Width One Shrub Transect...2.0m

Total Shrub Area...........200.0m2

Stakes Installed At........All 17

Burn and Duff Moisture..............Yes   Flame Zone Depth...........No

Postburn 100 Points Burn Severity...No   Herbaceous Fuel Load.......No

Herb. (FMH-15/17/21).......Yes

-----------------------------Forest Plot Protocols------------------------------

Overstory Live Tree Damage...........Yes   Live Crown Position.........Yes

Dead Tree Damage...........No   Dead Crown Position.........Yes

Record DBH Year 1..........Yes

Total Length Sample Area...50.0m   Total Width Sample Area.....20.0m

Total Sample Area..........1000.00m2

Quarters Sampled...........1 2 3 4

Minimum allowed DBH........0.0cm   Maximum allowed DBH.........999.9cm

Pole-size Live Height................Yes   Poles Tagged................Yes

Dead Height................Yes   Record DBH Year 1...........Yes

Total Length Sample Area...25.0m   Total Width Sample Area.....10.0m

Total Sample Area..........250.00m2

Quarters Sampled...........1

Minimum allowed DBH........2.5cm   Maximum allowed DBH.........15.0cm

Seedling Live Height................Yes   Seedlings Mapped............Yes

Dead Height................Yes   Dead Seedlings..............Yes

Total Length Sample Area...10.0m   Total Width Sample Area.....5.0m

Total Sample Area..........50.00m2

Subsample of Quarter.......1

Fuel Load Number of Sampling Planes..4 1 HR Plane Length...........6ft

10 HR Plane Length.........6ft 100 HR Plane Length.........12ft

1000 HR Sound Plane Length.50ft 1000 HR Rotten Plane Length.50ft

Calculate Dominance........Yes

Postburn Overstory Char Height......Yes

Pole-sized Postburn AssessmYes Pole-sized Char Height......Yes

Severity Transects Sampled.Fuel

FMH version 3.10, Printed on 02/27/03, 5:56:54 pm

Current directory: C:\Program Files\Microsoft SQL Server\MSSQL.1\MSSQL\Data

---------------------------------Description----------------------------------

Monitoring Type Code: FPIPO1T09 Date Described: 06/15/00

Monitoring Type Name: Ponderosa Dominated Forest

Preparer: Haggerty/Keifer/Dempsey (Updated T. Caprio 2012)

FGDC Association:

FMH-4 Version Title/Description: Ponderosa pine dominated forest

Visits Assigned: 00 PRE, 00 yr01, 00 yr02 (abandoned 2012), 00 yr04, 00 yr05, 00 yr10, 00 yr20, 00 yr27, 01 Pre, 01 Post, 01 yr01, 01 yr02 (abandoned 2012), 01 yr03, 01 yr05, 01 yr10, 01 yr30, 02 Pre, 02 Post, 02 yr01, 02 yr02 (abandoned 2012), 02 yr05, 02 yr10, 03 Pre, 03 Post, 03 yr01, 03 yr02 (abandoned 2012), 03 yr05, 03 yr10

Burn Prescription

Date of Burn (mo-mo)......07-15,11-30 Aspect (deg.).............0-0

Wind Direction (deg.)..... Spread Direction (B/H/F)..H

Fuel (tns/ac)...........0.0-0.0 Herb Moisture (%).......0-0

Live Woody (tns/ac).....0.0-0.0 Midflame Wind (mph).....0.0-8.0

Herbs (tns/ac)..........0.0-0.0 Rate of Spread (ch/hr)..1.0-18.0

Air Temp. (F)...........40-85 Heat per Area (btu/ftý).320.0-390.0

Rel. Humidity (%).......20-60 Fireline Intns (btu/ftý)4.0-120.0

1-hr TLFM (%)...........5-7 Slope (%)..............0-45

10-hr TLFM (%)..........8 Flame Length (ft).......1.0-4.0

100-hr TLFM (%).........9 Flame Zone Depth (ft)...0.0-0.0

1000-hr TLFM (%)........20 Scorch Height (m).......0.0-30.0

Woody Moisture (%)......0-0 Char Height (m).........0.0-0.0

Additional Prescription Information: (No information provided)

Management Objectives: Reduce the total fuel load by 60-95% immediately postburn.

Monitoring Objectives: Measure the mean total fuel load with a sample size which will allow us to be 80% confident that our results are within 25% of the true population mean.

Objective Variables: Total fuel load (tons/acre); incense cedar overstory density.

Physical Description: Aspect is south, west, or flat as in canyon bottoms.

Slopes range from 0-30%. Elevation begins at 4,500 with the lower and upper boundaries dependent on aspect. Soils are often but not always thin, and barren rock outcrops are common.

Biological Description: Overstory consists of at least 15% ponderosa pine (Pinus ponderosa), but often ranges to nearly complete dominance of the plot area.

Incense cedar (Calocedrus decurrens), black oak (quercus kelloggii) and canyon live oak (Q. chrysolepis) are present in varying degrees. Overstory maturity rating is in the medium to high categories. Understory is usually comprised of incense cedar, black oak and canyon live oak. Shrubs such as Manzanita (Arctostphylos spp.), buckbrush (Ceanothus spp.), gooseberry (Ribes spp.), Rubus spp., Prunus spp., Eriogonum spp., or bear clover (Chamaebatia foliolosa) compose a larger portion of the understory than in higher elevation forests.

Herbs are sparse to moderately common.

Rejection Criteria: Exclude riparian zones, anomalous vegetation patches, monitoring type boundaries, large rock outcroppings or barren areas (>20% of the plot), or areas within 20 meters of physical barriers such as roads or within 5 meters from any trail. Exclude areas where >25% of the overstory trees have been severely damaged by insects such as tussock moths.

Notes (This Entire Monitoring Type): Monitoring Type Notes, CRITICAL!: Read all the notes under the FSEGI monitoring type.

------------------------------General Protocols-------------------------------

Comments (Deviations, Problems, Omissions), this Version Only: (No information

provided)

Preburn Control Plots.............Yes Herb. Height..............Yes

Herbaceous Density.........No Abbreviated Tags...........Yes

0P/Origin Buried...........No Herbaceous Fuel Load.......No

Voucher Specimens..........Yes Brush Fuel Load...........No

Count Dead Branches of Living Plants as Dead.................No

Width "Observed" Transect..10.0m

Herb Transects Sampled.....Q4-Q1 Q3-Q2

Shrub Transects Sampled....Q4-Q1 Q3-Q2

Length One Shrub Transect..50m Width One Shrub Transect...1.0m

Total Shrub Area...........100.0m2

Stakes Installed At........17

Burn and Duff Moisture..............Yes Flame Zone Depth...........No

Postburn 100 Points Burn Severity...No Herbaceous Fuel Load.......No

Herb. (FMH-15/17/21).......Yes

-----------------------------Forest Plot Protocols------------------------------

Overstory Live Tree Damage...........Yes Live Crown Position.........Yes

Dead Tree Damage...........No Dead Crown Position.........Yes

Record DBH Year 1..........Yes

Total Length Sample Area...50.0m Total Width Sample Area.....20.0m

Total Sample Area..........1000.00m2

Quarters Sampled...........1 2 3 4

Minimum allowed DBH........0.0cm Maximum allowed DBH.........999.9cm

Pole-size Live Height................Yes Poles Tagged................Yes

Dead Height................Yes Record DBH Year 1...........Yes

Total Length Sample Area...0.0m Total Width Sample Area.....0.0m

Total Sample Area..........0.00m2

Quarters Sampled...........1

Minimum allowed DBH........2.5cm Maximum allowed DBH.........15.0cm

Seedling Live Height................Yes Seedlings Mapped............Yes

Dead Height................Yes Dead Seedlings..............Yes

Total Length Sample Area...25.0m Total Width Sample Area.....10.0m

Total Sample Area..........250.00m2

Quarters Sampled...........1

Fuel Load Number of Sampling Planes..4 1 HR Plane Length...........6ft

10 HR Plane Length.........6ft 100 HR Plane Length.........12ft

1000 HR Sound Plane Length.50ft 1000 HR Rotten Plane Length.50ft

Calculate Dominance........Yes

Postburn Overstory Char Height......Yes

Pole-sized Postburn AssessmNo Pole-sized Char Height......No

Severity Transects Sampled.Fuel

FMH version 3.10, Printed on 02/27/03, 5:55:54 pm

Current directory: C:\Program Files\Microsoft SQL Server\MSSQL.1\MSSQL\Data

----------------------------------Description-----------------------------------

Monitoring Type Code: FSEGI1T08 Date Described: 06/15/00

Monitoring Type Name: Giant sequoia-mixed conifer

Preparer: Haggerty/Keifer/Dempsey (Updated T. Caprio 2012)

FGDC Association:

FMH-4 Version Title/Description: Giant sequoia-mixed conifer forest

Visits Assigned: 00 PRE, 00 Post, 00 yr01, 00 yr02 (abandoned 2012), 00 yr04, 00 yr05, 00 yr10, 00 yr20, 00 yr30, 01 Pre, 01 Post, 01 yr01, 01 yr02 (abandoned 2012), 01 yr03, 01 yr04, 01 yr05, 01 yr08, 01 yr10, 01 yr12, 01 yr20, 02 Pre, 02 Post, 02 yr01, 02 yr02 (abandoned 2012), 02 yr05, 02 yr10, 02 yr20, 03 Pre, 03 Post, 03 yr01, 03 yr02 (abandoned 2012), 03 yr05

Burn Prescription

Date of Burn (mo-mo)......07-15,11-30 Aspect (deg.).............1-359

Wind Direction (deg.).....0-359 Spread Direction (B/H/F)..H

Fuel (tns/ac)...........35.0-100.0 Herb Moisture (%).......0-0

Live Woody (tns/ac).....0.0-0.0 Midflame Wind (mph).....0.0-10.0

Herbs (tns/ac)..........0.0-0.0 Rate of Spread (ch/hr)..0.0-8.0

Air Temp. (F)...........40-85 Heat per Area (btu/ftý).165.0-225.0

Rel. Humidity (%).......20-60 Fireline Intns (btu/ftý)1.0-35.0

1-hr TLFM (%)...........3-10 Slope (%)...............0-60

10-hr TLFM (%)..........11 Flame Length (ft).......0.0-2.5

100-hr TLFM (%).........12 Flame Zone Depth (ft)...0.0-0.0

1000-hr TLFM (%)........20 Scorch Height (m).......0.0-30.0

Woody Moisture (%)......0-0 Char Height (m).........0.0-0.0

Additional Prescription Information: (No information provided)

Management Objectives: Reduce the total fuel load by 60-95% immediately postburn. Reduce the total tree density to 50-250 trees/hectare for trees <80 cm DBH and 10-75 trees/hectare for trees >80 cm DBH.

Monitoring Objectives: Measure mean total fuel reduction with a sample size that will allow for 80% confidence in detecting a 40% change in fuel load and accepting a 20% chance of detecting a change that does not truly occur. Measure mean total tree density for trees <80 cm DBH and trees >80 cm DBH with a sample size that will allow for 80% confidence that the results are within 25% of the true population mean.

Objective Variables: Total fuel load (tons/acre); Total tree density by diameter class (trees/hectare)

Physical Description: All aspects. Slopes 20-60%,in drainage bottoms or broad upland basins, or occasionally steep slopes and ridgetops. Elevation from 5,500-8,000 feet. Soil depth ranges from shallow to very deep. Soils are generally rather coarse textured and acidic.

Biological Description: Overstory consists of mature white fir (Abies concolor), sugar pine (Pinus lambertiana), ponderosa pine (P. ponderosa), incense cedar (Calocedrus decurrens) and giant sequoia (Sequoiadendron giganteum). Due to the extreme size of the sequoia trees it is possible that no big trees will fall w/in the 20m by 50m plot area, however, mature trees should at least be within seed rain of the plot location. Overstory maturity is in the medium to high categories. Understory is usually comprised of incense cedar and white fir with occasional black oak (Quercus kelloggii). The forest floor is typically sparse, with few herbs. Shrubs such as chinquapin (Chrysolepis sempervirens), or hazelnut (Corylus cornuta) contribute <20% cover.

Rejection Criteria: Exclude riparian zones, anomalous vetetation patches, monitoring type boundaries, large rock outcroppings or barren areas (>20% of the plot), or areas within 20 meters of physical barriers such as roads or within 5 meters from any trail (exception for very small units). Exclude plots beyond the seed rain of giant sequoias.

Notes (This Entire Monitoring Type): Monitoring Type Notes: Critical! Some of the initial plots installed in this monitoring type were read according to a set of protocol that were in place prior to the implementation of the FMH handbook.

These older protocol will affect any FSEGI plots found from numbers 1-57. To determine if a plot is being monitored using these older methods, look for the SEKI-RMO Shrub/Major Herb, SEKI-RMO Tagged Tree form. If the forms are present prior to the last visit, but not within the most recent visit, the plots have already been converted to the FMH protocol. If, however, these forms are located in the last visit, you will need to read these plots in the following manner:

VEGETATION: The % of cover for plants is determined by starting at the OP end of the centerline tape and working towards the 50P end. All substrate materials (rock, wood, bole, bare) or plants are recorded if they occupy at least 5 cm worth of space along the center line. If, for example, litter is the substance at the beginning of the tape and it stretches until 1.03m along the tape, that is what gets recorded. Then, from 1.03m to 1.08m a rock may be found. If a plant, rock or other material bisects the top of the tape (transect plane) but occupies less than 5 cm worth of space, it is ignored and the primary substance that is present gets recorded instead. For example, if litter stretches from 0.00 to 1.03m, followed by a plant that covers from 1.03m to

1.04m, the older method would state that litter stretched from 0.00m to 1.04m. Hence, you will find that there is no break in the sequence of numbers being listed in the start-end-start columns. "Start" is where the tape measurement begins for each substance. "End" is the stopping point of the tape for that same item. "Dist" is the distance encompassed by the object.

Note: 1. For SEKI's purpose, on the veg line for both old and new style plots, wood is defined as a chunk of material that is over 3.0 inches in diameter.

Otherwise, smaller pieces of wood get recorded as litter. 2. Though not required by the FMH, SEKI has determined that it will reread the veg lines during postfire visits in order to determine changes in the %cover. 3. When old style plots reach the "reburn" status, the veg line is read both the old style way (described above) as well as according to the new FMH style as outlined in the book.

SEEDLINGS: Whether the FPIPO plots are being read old or new (FMH) style, seedlings should be done in the following manner. (Please note the differences between these protocol and those listed in the FMH. They are intended to increase our accuracy when seedling density is extreme, as well as to make the seedling maps more helpful, time efficient and accurate.)

SIZE CLASS 1: Never map these! Check in the folder to determine what area was sampled previously for SIZE CLASS 1. If it appears that the density is such that we can sample the same area, let's do so. If the previous sample size was very limited due to high density, and this density now appears to be greatly reduced, enlarge the sample area to the largest portion of Q1 that can reasonably be counted. (The reverse is also true. If the whole quarter was done previously but the density is astronomical now, we can lower the sample size.) Recommendations: If there are more than 300 seedlings in all of Q1, sample the 5 x 10m area proximal to the P1 line. If there are more than 300 seedlings in the 5 x 10, sample the four 1 meter square corners of Q1. By starting your count in the 5x10 you could save yourself a great deal of time should the densities prove to be higher than you originally estimated. Use the information on the modified FMH-14 data sheet to multiply out the subsample that was chosen. Enter your final number into the computer.

SIZE CLASS 2 and GREATER SEEDLINGS: Map and count all class 2 and greater seedling throughout the entire quarter, no matter what their density levels are, even if class 1 seedlings were only counted in the 4 corners! Remember, class 2 and above seedling need to be mapped on a FMH-16. No multiplication factors will be necessary for class 2 seedlings and above because they are always sampled throughout all of quarter 1.

Trees: (both old ((roughly #'s 1-57)) and new style plots ((#57+)): The same basic information has been gathered on trees since the inception of SEKI's program. To make data collection smoother, data is recorded on the FMH-8 form rather than the old SEKI-RMO form for Tagged Trees. The only deviation from FMH protocol is that we do not recognize pole-sized trees in the same manner. At SEKI, any tree over 1.37 m is considered to be part of the overstory despite what its diameter is. The FMH computer program states that our poles are >2.5 cm but <15.0. These smaller trees are still tagged (at DBH if possible, if not, look for a tag at the base) and are included when considering CPC codes. Hence, code 4 trees are generally quite small.

For FSEGI plots numbered 93+, 12 extra 10 x 25 m quarters were sampled for overstory SEGI trees. The schematic for the layout of these quarters is diagrammed on the direction sheet for plot 93 but it should be noted, that due to the obviousness of these huge trees, no extra rebar or tree tags were put in place to permanently mark this sampling area. Trees that show up w/ quater numbers 5-16 are for our information but do not get entered into the FFI software. Note: The sampling area was enlarged so that more SEGI trees would be captured. Due to their enormous size, a 20m x 50m plot may contain only 1 tree or even less of this species.

BRUSH DENSITY: In the past, brush density was conducted by guessing at what an individual was, or by counting clumps. Repeating these estimates proved to be futile. Hence, in 1997, we modified the brush protocol to fit local vegetation.

Density numbers prior to this time should not be used for purposes of analyses.

The modified FMH-18 (which is evidence of when each plot underwent the protocol change) should be used on all FABCO plots, whether they are old or new style.

Primary differences between this methodology and those listed in the FMH include:

1. Rather than guessing an individual, individual counts are done only when a single plant can truly be identified such as in the case of Cercocarpus, Fremontia and certain species of Arctostaphylos and Quercus.

2. Stem counts (which are not entered into the computer) will be conducted for brush species where telling the individual is not practical. (Examples: Chrysolepsis, Ribes, Adenostoma, Symphoricarpus and some species of Arctostaphylos and Quercus.)

3. Brush that is not practical to count by methods 1 or 2 will be picked up on the veg line only via %cover. Examples: Ceanothus, Prunus emarginata and Chamaebatia foliolosa.

For those Genera which have variable growth forms (Quercus, Arctostaphylos) it will be necessary to check the previous data sheet to determine which method was used. If species other than those listed above are found on a plot, a determination will be made in the field as to which method should be used. Note:

Pre and post fire growth forms were taken into account in developing these protocol.

FUELS: 4 Brown's transects are read on each plot according to protocol described in the FMH and Brown's handbook. Strange exceptions are outlined in the strange plot questions folder in the grey file cabinet in the back room (the one w/ the air conditioner.)

PHOTOS: Photos, where possible, are taken in the following manner using as a 200 speed Ektachrome slide film. Kneel on 1 knee, 10 ft. from the appropriate stake and take a Vertical picture. 8 photos are also taken of the Brown's lines wherein F F1-0 is Fuel transect 1, standing at the centerline. F1-50 is fuel transect 1, standing at the 50 ft. end, looking back at the centerline. Repeat photo: Starting in 1998, 1 photo was taken of each plot from the best location to get an overall view of the plot. Directions on how and where this was taken can be found on the photo sheets or on the white tab on the inside flap of each folder's brown manila jacket. When regular plot stakes were not used, 2 green stakes were used to mark the photo location. Tags on these will state: "Place clipboard here" and "stand here" so as to lessen confusion.

RED FLAG PLOT WARNINGS: Some of the earliest plots had some design error that was discovered upon subsequent visits (wrong size...so it was resized, Brown's lines run backwards etc). When a problem like this was identified, it was typed up on a sheet called the "Red Flag Warning" and inserted into the folder w/ a note on the plot cover, alerting you to the potential pitfall that lurks within.

How the problem was resolved is also included so it is worth your time to thoroughly read over these notes before proceeding

-------------------------------General Protocols--------------------------------

Comments (Deviations, Problems, Omissions), this Version Only: (No information

provided)

Preburn Control Plots.............Yes Herb. Height...............Yes

Herbaceous Density.........No Abbreviated Tags...........Yes

0P/Origin Buried...........No Herbaceous Fuel Load.......No

Voucher Specimens..........Yes Brush Fuel Load............No

Count Dead Branches of Living Plants as Dead.................No

Width "Observed" Transect..10.0m

Herb Transects Sampled.....Q4-Q1 Q3-Q2

Shrub Transects Sampled....Q4-Q1 Q3-Q2

Length One Shrub Transect..50m Width One Shrub Transect...1.0m

Total Shrub Area...........100.0m2

Stakes Installed At........All 17

Burn and Duff Moisture.............Yes Flame Zone Depth...........Yes

Postburn 100 Points Burn Severity...No Herbaceous Fuel Load.......No

Herb. (FMH-15/17/21).......Yes

-----------------------------Forest Plot Protocols------------------------------

Overstory Live Tree Damage...........Yes Live Crown Position.........Yes

Dead Tree Damage...........No Dead Crown Position.........Yes

Record DBH Year 1..........Yes

Total Length Sample Area...50.0m   Total Width Sample Area.....20.0m

Total Sample Area..........1000.00m2

Quarters Sampled...........1 2 3 4

Minimum allowed DBH........0.1cm   Maximum allowed DBH.........999.9cm

Pole-size Live Height................No   Poles Tagged................No

Dead Height................No   Record DBH Year 1...........No

Total Length Sample Area...0.0m   Total Width Sample Area.....0.0m

Total Sample Area..........0.00m2

Quarters Sampled...........1

Minimum allowed DBH........2.5cm   Maximum allowed DBH.........15.0cm

Seedling Live Height................Yes   Seedlings Mapped...........Yes

Dead Height................Yes   Dead Seedlings.............Yes

Total Length Sample Area...25.0m   Total Width Sample Area.....10.0m

Total Sample Area..........250.00m2

Quarters Sampled...........1

Fuel Load Number of Sampling Planes..4   1 HR Plane Length...........6ft

10 HR Plane Length.........6ft   100 HR Plane Length.........12ft

1000 HR Sound Plane Length.50ft   1000 HR Rotten Plane Length.50ft

Calculate Dominance........Yes

Postburn Overstory Char Height......Yes

Pole-sized Postburn AssessmNo   Pole-sized Char Height......Yes

Severity Transects Sampled.Fuel

D - Fire and Fuels Research Plan

Natural, cultural, and social science research is and will continue to be an important activity in these parks. Research in this document is defined as any scientific method that informs the fire management program including monitoring and modeling, as well as traditional research projects. It serves two primary purposes in relation to the fire and fuels management program. First, it helps to define both natural fire regimes as well as the range of natural conditions that serve as ecological foundations for the application of fire in park ecosystems. Second, it is used as a tool to evaluate actions used to restore and/or perpetuate desired conditions as contemplated in the policies for management of natural areas in the NPS. This research can have either tactical or strategic applications. Such research will continue to be encouraged and supported in an effort to further improve the parks' fire and fuels management program.

Considerable fire research has been carried out in Sequoia and Kings Canyon National Parks over the past several decades. This work has included a variety of studies in: sequoia-mixed conifer forests (Kilgore 1972, Kilgore and Taylor 1979, Parsons and DeBenedetti 1979, Harvey and others 1980, Stephenson and others 1991; Swetnam and others 1992, 1998; Swetnam 1993; Mutch 1994; Caprio and Swetnam 1995; Stephenson 1994; Miller and Urban 1999, 2000; Stephens and Finney 2002; Knapp et al. 2005; Ferrenburg et al. 2006; Keifer et al. 2006; Knapp and Keeley 2006; Schwilk et al. 2006; Collins et al. 2007; Collins and Stephens 2007; Knapp et al. 2007; North et al. 2007, Scholl and Taylor 2010, Swetnam et al. 2009; Van de Water and North 2011); low elevation foothill communities (Rundel and Parsons 1979, Parsons 1981, Rundel and others 1987; Keeley et al. 2005a, 2005b); and high elevation forests and meadows (Vankat 1970; Kilgore 1971, DeBenedetti and Parsons 1984; Pitcher 1981, 1987; Caprio 2004a, 2004b, 2008).

These studies have provided a firm justification and basis for the development of the parks' prescribed and natural fire management programs (Bancroft and others 1985). While much is known from these studies, in most cases they have not provided the full level of detail necessary to completely understand natural fire regimes or the effects of variable intensity fires on subtle ecosystem properties.

Research needs and priorities are jointly identified by the Division of Resources Management and Science and the USGS Southern Sierra Field Station (formerly NPS Research Office) located within the parks. They are documented in the parks' Natural Resources Management Plan and updated annually. Such research may include in-house studies, interagency or cooperative agreements, contracts, or independent investigations. All fire related research is closely coordinated with fire operations and fire monitoring efforts to assure maximum application of findings to both the management and interpretation programs. The Fire Ecologist within the Division of Resources Management and Science assists in coordinating these efforts. A report is produced annually documenting all fire-related research, monitoring, and inventory projects undertaken within a given year.

Most fire research is carried out in close conjunction with the prescribed burning program, utilizing planned burns to the extent possible. On occasion, burns will be carried out specifically to support approved research projects. These might include efforts to study the effects of variable intensity burns, reburns, or burns carried out under specific climatic or prescription variables (e.g. severe drought).

FIRE RESEARCH NEEDS

Fire research is directed at answering questions related to short-term, specific operational or resource issues or at big picture ecosystem wide problems that may have long-term or far-reaching implications for park management. Specific research questions may be addressed by park staff, staff from other agencies (e.g. USGS), or by outside researchers. Current research needs focus on obtaining a better understanding of spatial and temporal patterns of past fire regimes, the effects of fire intensity and frequency on fuel accumulation and on forest structure and dynamics, and the many effects of variable fire intensities and return intervals, as well as fire suppression, on vegetation, fauna, pathogens and other ecosystem properties. The question of the extent to which contemporary vegetation and fuels vary from their natural range has been difficult to determine yet remains a key factor for guiding fire management decisions. The following specific fire-related research needs have been identified:

Fire and Global Change: Understanding Forest Dynamics, Succession Modeling, Climate and Vegetation History, and Ecology of Sequoia - Mixed Conifer Forests

Aspects of this comprehensive need are currently being addressed by ongoing studies by and through the USGS Research Office. These are addressing vegetation and fire history over millennial time scales, forest structure, fuel accumulation and modeling, effects of variable fire intensity on pathogens and cambium and soil temperatures and various aspects of nutrient cycling. Beyond the continuation and expansion of the above projects, additional research is needed relating to mixed conifer forest fire ecology including expanded studies of fire and vegetation history (in conjunction with larger proposed studies of global change), plant succession and forest dynamic models (to permit testing of predictive outcomes of different climate and management scenarios), and fire spread modeling.

Role of Fire in Sierran Ecosystems

Improve the Reliability of Information Used to Derive Desired Structural/Process Goals

These conditions were established by the November 1998 Sacramento workshop "Setting Resource Objectives for Fire Management Plans". Defining the desired goals used in this ecosystem management process requires an understanding of basic reference conditions at various landscape levels. Currently our knowledge of these reference conditions is poor, of low resolution, and only provides a broad target window for fire management planning. At this time, of the two goals, past process conditions can probably be more easily and reliably reconstructed.

Structural Goals

These goals include landscape pattern, physical and biological attributes of stand structure, and their drivers. This information need encompasses pre-Euro-American settlement tree ages and age distributions, species diversity, size structure by vegetation type, gap and patch size, shape and arrangement on the landscape, species composition, and burn severity by topographic position. A variety of sources may potentially provide this information including historic photography, TM images, and field investigations. Changes in attributes such as species diversity could be obtained by investigating changes pre-/post-fire, after multiple burns in an area, and by following burns with differences in seasonal timing and burn intervals (also see cross-scale burn severity below).

Process Goals

These goals include an understanding of the attributes of pre-Euro-American settlement fire regimes, drivers of these regimes, and the relationship between these and other agents of change. While considerable fire history sampling has been carried out within the parks (Kilgore and Taylor 1979; Pitcher 1987; Swetnam and others 1992; Swetnam and Caprio 1995; Swetnam and others 1998; Caprio 1999) many significant gaps still exist in our knowledge (Caprio and Lineback 1997). Information needs include obtaining an improved understanding of the historic size, frequency, type, and intensity of fire, and a comparison of the extent of historic fire patterns across the landscape and for the various vegetation types within the parks. Additionally, an evaluation of the constraints imposed by the presence of modern park developments and park neighbors is needed. This information will help define areas where the restoration of the historic fire regime and patterns may be constrained.

Cross-Scale Burn Severity Through Several Burns

Patterns and changes in patterns of burn severity would be examined over time as repeated burns occur on the landscape. This would provide information on spatial and temporal patterns of burn severity and how they change as multiple burns occur. For example, does fire size change between the first and second burns. Specific projects might include looking at fire records and burn maps from the Sugarloaf (SEKI) and/or Illilouette (YOSE) Valleys.

Fire Ecology of Low Elevation Mixed Conifer and Hardwood Forests

Research is needed to better understand the role of fire in the transition zone between the foothill chaparral and the mixed conifer forests. This should include studies of fire history, fuel loading, and vegetation structure and succession, as well as modeling of fuels, fire behavior and fire spread. This key zone between the highly flammable foothill and sensitive sequoia forests is extremely important to the overall fire management strategy of the parks.

Subalpine Forest Fire Ecology

Despite an active program of allowing natural fires to burn in the higher elevations of the Parks little is known about fire history and effects in most of these ecosystems. Such data is needed for lodgepole pine, red fir and other subalpine forest types as well as for subalpine meadows, which comprise a significant portion of the parks' vegetation. Our current knowledge of fire effects in these types is largely confined to studies of limited extent carried out by Kilgore (1972), Pitcher (1980, 1987) or presently underway by Battles and Newburn (2000) and Caprio (2000, 2009).

FIRE MODELING AND DATA NEEDS

Fire Behavior Modeling

Modeling for the prediction of fire behavior, such as the BEHAVE/FARSITE systems, and the development of Geographic Information Surveys for the storage of fuels data

Historic Fire Spread Patterns

Model fire spread patterns of fires originating from ignition starts that have occurred over last X number of years to see whether burn patterns/frequency fir with past patterns or does data suggest Native American burning was important.

Air Quality

Research is needed to determine the number of acres that can be burned without violating air quality regulations. Monitoring equipment is needed to establish baseline particulate loading in park airsheds and what is the contribution of the parks burn program. By knowing how many pounds of particulates or CO are produced per ton of any given fuel, and by studying the indicators of good and bad smoke dispersion days, improved prescriptions may be written for smoke management, as is done for fire behavior and effects.

Watershed Impacts

A better understanding of both transitory and long-term effects on watershed features related to the presence or absence of fire. Included would be hydrologic and sedimentation impacts, stream chemistry, and changes in soils. Studies are needed that provide results from replicated watersheds in a variety of setting such as differing vegetation and parent material.

Wildlife

Several potential research/resource study projects for examining the relationship between fire and wildlife. These include:

- Fire or absence of fire and its effects on particular wildlife species. Particular taxa would include terrestrial amphibians, bats, spotted owls, and fishers.
- Historic role of fire in maintaining winter range of bighorn sheep in the Kern and Big Arroyo drainages. For example, did fire historically keep areas open that are now very brushy? This could be addressed by either looking at historic photos or by reconstructing the fire history of the area.
- What are the effects of tussock moth on forest structure, composition, and fuels relative to prescribed burns? Do these effects differ between areas burned prior to the moth outbreak?

Fire Effects on Sensitive or Endangered Species

Fire effects or the effect of the lack of fire on sensitive or endangered plants and animals within the parks. Wildlife species might include fishers, spotted owls, or Sierra bighorn sheep. For example, recent interest has been expressed on the relationship between fire and bighorn sheep habitat. Potential investigation might include looking at change in habitat and foraging behavior that might occur with future fires and understanding the relationship between fire and sheep habitat in the past (prior to Euro American settlement).

Exotic Plants and Animals and Fire

While dramatic changes in most low elevation grasslands occurred over a century ago new invasions or potential invasions of exotic species are still occurring or threaten. For example, in the last three years the widespread occurrence and dominance of cheatgrass has become apparent. While multiple factors are usually important in the spread, establishment, and dominance of these invasive species fire can sometimes have a significant role. Studies are needed to investigate the role of fire in association with other factors in the spread of established or threatening exotics. In general, studies are needed to determine:

- Strategies to detect the presence and changes in exotics over time
- What are the interactions between fire and other management practices (roads/stock etc.) on establishment and spread of exotic species
- Can methods be developed to eliminate particular exotic species or at least retard their spread

Fire Restoration Needs

A long-term examination of fire restoration potential is needed. For example, at what interval can fires occur in various vegetation types and still maintain the character and integrity of the ecosystem. Can we maintain systems that burned at 5-year intervals historically with a 10-year fire return interval? Additionally, how important is the fire return interval distribution of fire (Bond and Wilgen 1996) or the variation in intervals from fire-to-fire? Again can we use patterns that are different from pre-settlement patterns and still maintain ecosystem integrity. These extend the JFS Fire and Fire Surrogates work currently underway within the parks.

Conversion of Sequoia Tree Inventory into Digital Format

An exhaustive inventory of all giant sequoia trees in the parks was carried out under contract in the 1960's and 70's. This data has great potential value to both management and science programs. However, it currently exists only in hard copy form and is of limited utility. Converting the paper database into a digital georeferenced format and georeferencing tree locations would greatly increase the utility of this dataset.

SENSITIVE RESEARCH AREAS

Specific "*Sensitive Research Areas*" may be designated to support particular research projects or objectives. The purpose of these areas is to provide a mechanism for identifying and highlighting areas in the fire planning process where special considerations are required during implementation of burns. These areas would include fire research plots where the effects of variable fire intensities, intervals or fuel conditions might be under study. Plots would be variable sized areas established by the park's fire monitoring and USGS research programs, university scientists and other federal agencies. One special type of *sensitive research area* would be sites where fire exclusion is called for. These areas will be individually justified and managed according to objectives stated in approved research project plans and be subject to annual or periodic review. These areas would fall into two categories:

Temporary Areas

Sites that may be used for a limited amount of time or set aside to be excluded from one particular burn (these would be most applicable to prescribed fire situations). They might be designated in either unburned areas or in areas that have burned at some point in the recent past. The number of sites would be dynamic on a year-by-year basis. An example would be the

Giant Forest Joint Fire Science (JFS) "fire and fire surrogates" study area where several control treatments will be paired with burn treatments. Control areas will be maintained for the life of the study (~5 yr.) but will revert back and be included in any additional fire operations planning with the completion of the study. Examples include:

- Giant Forest Joint Fire Science program plots
- Cheatgrass plots in Cedar Grove
- Pitcher Plot #3 - Desired plan: to miss the next prescribed fire in the area. Reason: to act as control for Plots 1 and 2 that were burned during 1999. This will permit effects of the burns in plots 1 and 2 to be more accurately compared to a similar unburned area in which similar long-term data has been collected.

Long-term or Semi-Permanent Areas

Areas where fire is being actively excluded in an effort to evaluate the effects of long-term fire exclusion on ecosystem properties. These would be sites without a definite life span or annual evaluation. Location and designation of these areas will be based on specific criteria such as feasibility of fire control or exclusion and the value of long-term maintenance to the parks research program. An example of such a site would be the 49.8 ha Log watershed in Giant Forest that has been paired with the burned Tharps watershed in several long term studies of acid deposition and fire on ecosystem properties.

E - Fuels Management Prescriptions

MECHANICAL HAZARD FUELS ABATEMENT STANDARDS

Hazard Abatement Adjacent to Structures, Around Developments, and Along Park Boundary Areas

The following standards will be used for hazard fuels abatement projects conducted by park crews on NPS lands:

- The removal of exotics should be favored over the removal of native species. Where feasible, exotics should be eliminated while native plants should be pruned or isolated from the ladder effect in order so that they may remain while providing a reasonable level of protection for structures.
- There may be sensitive native plants in certain areas and the removal of nesting trees should be done after birds have vacated the nests. Coordinators of abatement projects will need to consult with the park biologist before cutting questionable plant species or nesting trees.

Foothill Areas

In foothill areas where annual grass and shrub species comprise the main hazardous fuels, most mechanical reduction work is done immediately adjacent to structures. The following standards are guided by California's PRC 4290 and PRC 4291.However, the parks may adapt these standards based upon resource management concerns or fire management staff expertise.

- Mow or cut dried grass from the sides of structures out to a minimum 30 foot width from the structures in all directions. On steep hillsides mow or cut dried grass out to a distance of up to 100 feet on the downhill portion. Individual live shrubs or trees can remain as long as they are isolated from the ladder effect—the path that fires can travel in order to reach the structure's sides or roof area.
- Along the sides of flammable foundations, scrape away fuels down to bare mineral soil. A 2 to 3 foot wide scrape is recommended.
- Remove all leaf litter from roofs.
- Remove all dead branches within a reasonable distance above roofs (some conifer trees could have dead branches high up in the tree that are not reachable).
- Remove all branches or vegetation within 10 feet of chimney outlets.
- All fireplace or wood stove chimney outlets must be covered with an ember-arresting screen that has openings no larger than ½ inch in size.
- Limb-up all trees 6 to 8 feet above the ground and that are within a minimum area 30 feet out from structures in all directions.
- When removing a lateral branch at its point of origin on the trunk or parent limb, the final cut shall be made in branch tissue close to the trunk or parent limb, without cutting into the branch bark ridge or collar, or leaving a stub.
- When removing a dead branch, the final cut shall be made just outside the collar of live tissue. If the collar has grown out along the branch stub, only the dead stub shall be removed. The live collar shall remain intact and uninjured.
- To prevent damage to the parent limb when removing a branch with a narrow branch attachment, the final cut shall be made from the bottom of the branch up.

- Tree branches shall be removed in such manner so as not to cause damage to other parts of the tree. Branches too large to support with one hand shall be pre-cut to avoid splitting or tearing of the bark.
- Piles shall be appropriately sized and located in openings far enough away from residual vegetation in order to prevent or minimize scorch.
- Piles shall have a minimum height of 3 feet and a maximum height of 6 feet.
- Piles shall be located at least 15 feet from any residual green tree in the downhill or side-slope direction from the pile, and at least 20 feet from any residual green tree upslope of the pile.
- Piles shall be constructed reasonably compact and free of soil to facilitate burning.
- Piles shall also be constructed with enough fine material (less than ¼ inch diameter), such as twigs and needles, to easily ignite and burn the pile.
- All piles should have a good base to prevent the pile from toppling.
- Piles shall be covered with durable paper prior to precipitation. Water-resistant “Kraft” paper (Clean Burn Kraft Paper – available from http://www.baileys-online.com/store.html) or approved substitute may be used. No plastic material will be used to cover piles. The covering shall be placed over the center of the pile. The paper shall cover a minimum of 75% of the surface of each pile.
- Pieces of branch wood shall be placed on the top to secure the paper against reasonable wind events.

Mid-elevation Areas

In mid-elevation areas where timber species comprise the main hazardous fuels, mechanical reduction work is done immediately adjacent to structures and out to about a 200-foot width on average in all directions. On steep slopes the areas downhill or below structures may need mechanical reduction work wider than 200 feet. In timber fuels shaded fuel break techniques are used. The following standards are guided by California’s PRC 4290 and PRC 4291. However, the parks may adapt these standards based upon resource management concerns or fire management staff expertise.

- Remove flammable vegetation or leaf litter from the sides of structures to 30 feet out from the structures in all directions. Individual live shrubs or trees can remain as long as they are isolated from the ladder effect—the path that fires can travel in order to reach the structure’s sides or roof area.
- Along the sides of flammable foundations, scrape away fuels down to bare mineral soil. A 2 to 3 foot wide scrape is recommended.
- Remove all leaf litter from roofs.
- Remove all dead branches within a reasonable distance above roofs (large conifer trees could have dead branches high up in the tree that are not reachable).
- Remove all branches or vegetation within 10 feet of chimney outlets.
- All fireplace or wood stove chimney outlets must be covered with an ember-arresting screen that has openings no larger than ½ inch in size.
- There will be a maximum of 25 trees/acre less than 40 feet in height remaining after the thinning.
- All live trees over 40 feet tall will remain uncut. All larger trees remaining will be limbed up to at least 6 to 8 feet above the ground.

- When removing a lateral branch at its point of origin on the trunk or parent limb, the final cut shall be made in branch tissue close to the trunk or parent limb, without cutting into the branch bark ridge or collar, or leaving a stub.
- When removing a dead branch, the final cut shall be made just outside the collar of live tissue. If the collar has grown out along the branch stub, only the dead stub shall be removed. The live collar shall remain intact and uninjured.
- To prevent damage to the parent limb when removing a branch with a narrow branch attachment, the final cut shall be made from the bottom of the branch up.
- Tree branches shall be removed in such manner so as not to cause damage to other parts of the tree. Branches too large to support with one hand shall be pre-cut to avoid splitting or tearing of the bark
- Felled trees will be limbed and bucked down to an 8-inch top and piled for later burning. Tree boles larger than 8 inches in diameter will be left un-bucked. All tree boles left will remain in contact with the ground. All stumps will be flush cut and added to the burn piles.
- Dead & down woody material (1-8 inches in diameter) will be gathered and piled with larger logs limbed and bucked to an 8-inch top and piled for later burning. Tree boles larger than 8 inches in diameter will be left un-bucked.
- Piles shall be appropriately sized and located in openings far enough away from residual vegetation in order to prevent or minimize scorch.
- Piles shall have a minimum height of 3 feet and a maximum height of 6 feet.
- Piles shall be located at least 15 feet from any residual green tree in the downhill or side-slope direction from the pile, and at least 20 feet from any residual green tree upslope of the pile.
- Piles shall be constructed reasonably compact and free of soil to facilitate burning.
- Piles shall also be constructed with enough fine material (less than ¼ inch diameter), such as twigs and needles, to easily ignite and burn the pile.
- All piles should have a good base to prevent the pile from toppling.
- Piles shall be covered with durable paper prior to precipitation. Water-resistant “Kraft” paper (Clean Burn Kraft Paper – available from http://www.baileys-online.com/store.html) or approved substitute may be used. No plastic material will be used to cover piles. The covering shall be placed over the center of the pile. The paper shall cover a minimum of 75% of the surface of each pile.
- Pieces of branch wood shall be placed on the top to secure the paper against reasonable wind events.
- Larger brush patches will have a minimum 20-foot wide path cleared, and the cut material piled for later burning to facilitate future fire line construction located in a defensible area within the treatment area.
- Any stumps larger than 8 inches in diameter will be treated with borax to prevent root rot.
- The treatment zone will be maintained on a regular and recurring basis.
- Established seedlings and saplings will be thinned every 10-15 years to maintain stocking densities at prescribed levels favoring shade intolerant species. The slash generated will be piled and burned.
- The 20-foot wide cleared brush zone will be maintained by cutting sprouting brush on a 3-5 year cycle. The cut material will be piled and burned.
- Re-accumulations of dead & down woody material will be gathered and piled with larger logs limbed and bucked to an 8-inch top and piled for later burning on a 1-2 year cycle.

Hazard Abatement Along Boundary Areas

Where hazard abatement along park boundary areas needs to be implemented, the treatments will follow the shaded fuel break methodology described above. For brevity reasons those standards are not duplicated here.

PRESCRIBED FIRE BURNING PRESCRIPTIONS

Table E-1: Prescriptions for Fuel Models 1-5

	Fuel Model 1 Annual Grass Head Fire Wind Upslope	Fuel Model 1 Annual Grass Backing Fire Wind Upslope	Fuel Model 2 Annual Grass with Overstory Head Fire Wind Upslope	Fuel Model 2 Annual Grass with Overstory Backing Fire Wind Upslope	Fuel Model 4 Tall Brush Head Fire Wind Upslope	Fuel Model 5 Low Brush Head Fire Wind Upslope
Environmental Conditions						
Air Temperature	30–90 f	30-90 f	30-90 f	30-90 f	30-85 f	30-80 f
Relative Humidity	20–80%	20-80%	20-80%	20-80%	20-80%	20-80%
Wind Speed	See Below	See Below	See Below	See Below	See Below	See Below
Slope	0–30%	0-100%	0-30%	0-100%	0-45%	0-35%
Fuel Moisture						
1 Hour Time Lag	5-10% mfws 0-2	3-4% mfws 0-4 5-10% mfws 0-2	6-11% mfws 0-2 12-13% mfws 0-6	4-9% mfws 0-4 10-13% mfws 0-2	5-9% mfws 0-4 10-12% mfws 0-8	5-7% mfws 0-2 8-12% mfws 2-8 w/ live fuel moisture of 100-150%
10 Hour Time Lag	N/A	N/A	7-12% mfws 0-2 13-14% mfws 0-6 15-16% mfws 0-10	5-10% mfws 0-4 11-14% mfws 0-2	6-10% mfws 0-4 11-13% mfws 0-8	6-12% mfws 0-2 9-13% mfws 0-8 w/ live fuel moisture of 100-150%
100 Hour Time Lag	N/A	N/A	8-13% mfws 0-2 14-15% mfws 0-6 16-17% mfws 0-10	6-11% mfws 0-4 12-15% mfws 0-2	7-11% mfws 0-4 12-14% mfws 0-8	N/A
1,000 Hr Time Lag	N/A	N/A	N/A	N/A	N/A	N/A
Live	N/A	N/A	50-100%	50-100%	50-150%	70-150%
Fire Behavior Outputs						
Scorch Height	N/A	N/A	0-30 ft.	0-30 ft.	N/A	N/A
Rate of Spread	2-35 chains/hour	2-8 chains/hour	1-16 chains/hour	1-3 chains/hour	2-120 chains/hour	2-17 chains/hour
Flame Length	0-4 ft.	.5-2 ft.	.5-4 ft.	.5-2.5 ft.	3-25 ft.	1-5 ft.
Heat per Unit Area	55-95 BTU/sq. ft.	100-110 BTU/sq. ft.	255-495 BTU/sq. ft.	255-525 BTU/sq. ft.	1570-2910 BTU/sq. ft.	215-715 BTU/sq. ft.
Fireline Intensity	3-60 BTU/sq. ft./second	4-15 BTU/sq. ft./second	4-145 BTU/sq. ft./second	4-30 BTU/sq. ft./second	50-6330 BTU/sq. ft./second	7-221 BTU/sq. ft./ second

NOTE: These are generalized burning prescription parameters. Fire management staff are responsible for reviewing topography outside the range listed and adjusting ignition pattern and rate of firing in order to meet burn plan objectives. Reduction of scorch can be accomplished as needed generally with nighttime ignition and with humidities higher than 30%.

Table E-2: Prescriptions for Fuels Models 8-10

	Fuel Model 8 Closed Timber and Short Needle Conifer Head Fire Wind Upslope	Fuel Model 9 Broadleaf Deciduous Hardwoods and Long Needle Pine Head Fire Wind Upslope	Fuel Model 9 Broadleaf Deciduous Hardwoods and Long Needle Pine Backing Fire Wind Upslope	Fuel Model 10 Timber Litter Head Fire Wind Upslope	Fuel Model 10 Timber Litter Backing Fire Wind Upslope
Environmental Conditions					
Air Temperature	30-85 f	30-85 f	30-85 f	30-85 f	30-85 f
Relative Humidity	20-80%	20-80%	20-80%	20-80%	20-80%
Wind Speed	See Below	See Below	See Below	See Below	See Below
Slope	0-60%	0-45%	0-100%	0-45%	0-100%
Fuel Moisture					
1 Hour Time Lag	3-10% mfws 0-10	5-7% mfws 0-6 8-12% mfws 0-8	3-10% mfws 0-4	5-7% mfws 0-6 8-12% mfws 0-8	3-10% mfws 0-4
10 Hour Time Lag	4-11% mfws 0-10	6-8% mfws 0-6 9-13% mfws 0-8	4-11% mfws 0-4	6-8% mfws 0-6 9-13% mfws 0-8	4-11% mfws 0-4
100 Hour Time Lag	5-12% mfws 0-10	7-9% mfws 0-6 10-14% mfws 0-8	5-12% mfws 0-4	7-9% mfws 0-6 10-14% mfws 0-8	5-12% mfws 0-4
1,000 Hr Time Lag	10-40%	10-40%	10-40%	10-40%	10-40%
Live	N/A	N/A	N/A	N/A	N/A
Fire Behavior Outputs					
Scorch Height	0-30 ft.	0-30 ft.	0-30 ft.	0-30 ft.	0-30 ft.
Rate of Spread	0-8 chains/hour	1-18 chains/hour	0-1 chains/hour	1-18 chains/hour	0-1 chains/hour
Flame Length	0-2.5 ft.	1-4 ft.	.5-3 ft.	1-4 ft.	.5-3 ft.
Heat per Unit Area	165-225 BTU/sq. ft.	320-390 BTU/sq. ft.	350-450 BTU/sq. ft.	320-390 BTU/sq. ft.	350-450 BTU/sq. ft.
Fireline Intensity	1-35 BTU/sq. ft. /second	4-120 BTU/sq. ft. /second	4-60 BTU/sq. ft. /second	4-120 BTU/sq. ft. /second	4-60 BTU/sq. ft. /second

NOTE: These are generalized burning prescription parameters. Fire management staff is responsible for reviewing topography outside the range listed and adjusting ignition pattern and rate of firing in order to meet burn plan objectives. Reduction of scorch can be accomplished as needed generally with nighttime ignition and with humidities higher than 30%.

F - GIS and Data Management Plan

Geographic Information Systems (GIS) are an essential tool for a successful fire and fuels management program. The technologies used and capabilities of GIS are evolving rapidly. This section of the *Fire and Fuels Management Plan* describes GIS data management objectives, roles and responsibilities, hardware and software, existing data, data collection and analysis, and interagency collaboration.

It is very important that information be collected according to well-defined standards, managed to protect long-term data integrity, and be made accessible to the staff and public. It should be kept in mind that data management is a dynamic process and this document is subject to an annual review process where changes may be integrated.

This document does not address all fire data management activities at Sequoia and Kings Canyon National Parks (SEKI), as many of these activities integrate with local parkwide and service-wide protocols, applications, and standards. The SEKI fire management program has implemented applicable sections of the Sierra Nevada Data Management Plan (Cook and Lineback, 2006). These plans offer some guidance for park programs and outline how we intend to implement and maintain data management systems and best practices that optimize the data and information needs of selected programs. These plans reflect our commitment to ensure the quality, interpretability, security, longevity, and long-term availability of high-quality data and information. This is accomplished through standards and guidelines outlined for:

- Proper work flow and management of data through a projects life cycle
- Data management responsibilities of each person involved with a project
- Quality assurance and quality control measures that should become standard practice
- Documentation of projects (project development summaries and SOPs) and data sets (formal metadata)
- Handling and protection of sensitive data and information
- Dissemination to the public of non-sensitive data and information
- Proper management, archival, and storage of all records and objects associated with projects
- Project organization and tracking
- Document Citation: Cook, R. R. and P. Lineback, 2006. Sierra Nevada Network Data Management Plan. Natural Resource Report NPS/PWR/SIEN/NRR—2006/000. U.S. National Park Service, Three Rivers, California.
- This appendix addresses only those GIS data activities specific to these parks and national systems to which these parks contribute.

GIS DATA MANAGEMENT OBJECTIVES

- Sufficient data is available to support park fire planning and operations.
- All significant spatial data within the parks is adequately documented, archived, and secured using appropriate methodologies, tools and technologies.
- Staff is adequately trained in the use of technologies, standards, and procedures.
- Access to data and supporting documentation is easy to use, readily retrievable, and well documented through use of available NPS and NIFC software systems and Internet technologies.
- Data collection and data handling protocols follow approved standard operating procedures, incorporate appropriate standards, and meet best science standards.
- The parks participate in interagency, cross-boundary data development initiatives such as the Southern Sierra Fire Management Officers group (SSFMO).

ROLES AND RESPONSIBILITIES

Fire GIS Specialist

A permanent GS-9/11 Fire GIS Specialist is duty stationed at SEKI and supervised by the GIS Coordinator under the Division of Natural Resources. This position is funded by fire management. A minimum of 80% of the position supports GIS for fire and fuels management information activities. The Fire GIS Specialist is responsible for providing data, analysis, and services for fire planning and operations and works closely with the fire management staff and the GIS Coordinator. Support is provided to interagency GIS initiatives as needed to support landscape-level GIS data management and analyses. This position also assists with providing GIS and GPS training to park staff, ensures data backups and documentation of data and processes including metadata, resolves technical support questions from staff, and handles basic system administration functions for computer servers and workstations.

GIS Coordinator

The GIS Coordinator manages the overall direction for the GIS fire program and provides backup support to the Fire GIS Specialist.

Fire Planner

A permanent GS-11 Fire Planner works with the GIS fire program and provides backup support and interagency coordination for the fire program.

HARDWARE AND SOFTWARE

Computer systems

At SEKI, data management is based on a Windows client-server model for distributing data and information. The parks' IT staff handles the overall administration of this network. The fire management staff has access to this internal network. All park GIS and FFI data now reside on Windows based servers within this network, housed in the IT server room.

Archiving and Security

All digital data is backed up on park data servers. These data servers are backed up nightly. Rotating copies of the backups are stored in a fire safe vault in the administrative offices at Ash Mountain headquarters. In conjunction with the IT staff, the GIS staff has created processes and procedures for ensuring best data management practices relating to archiving and accessing GIS data. The Fire GIS Specialist and the GIS Coordinator both have system administrator access to data on the park GIS servers for manipulating and creating datasets, and for granting users access to files.

Software and Data Accessibility

GIS Software

The parks use ESRI's ArcGIS software for GIS processing and mapping. Several extensions to ArcGIS are utilized, such as Spatial Analyst. ArcGIS Software can be installed from the parks' internal sharepoint site on the Maps tab. Additionally the fire program has an internal web mapping site for viewing fire GIS information.

SQL Server, ArcSDE and ArcServer

The parks provide GIS master data access via SDE on a SQL Server. The combination of the data and server side software makes up the SEKI Spatial Data Warehouse. The warehouse allows for consolidation and assuredness that the most readily available data is what's being used. The parks also provide a subset of this data through web mapping services available through web browsers.

Layer Files for GIS Data

The parks maintain an ArcGIS Layer Files directory so that users can easily locate the most up-to-date GIS data and ensures that everyone uses a common set of symbology. These Layer Files are stored on the GIS servers and locations are available via the SEKI Sharepoint Maps page. A link to these is created automatically for users who install ArcGIS Desktop via the internal sharepoint site.

Metadata

Digital geo-spatial data will be documented using the FGDC Content Standards for Digital Geo-spatial Metadata, version 2. Currently the GIS staff is using the ArcGIS Metadata tool for creation and maintenance of metadata.

GPS Software

- Trimbles - The parks use Trimble's GPS Analyst and Pathfinder office software to provide post-processing correction services for the Trimble GeoXT and Juno units. These licenses resides on the WASO GIS server in Denver and can be accessed by anyone who needs to use this. Pathfinder Office is a standalone program that processes data from units that use Terrasync. GPS Analyst processes data from units that use ArcPad and GPSCorrect.
- Garmins – the Fire GIS Specialist has a copy of the Garmin 24K topo data that can be loaded on Garmin GPS units for fire staff. Also, most staff use the DNR Garmin download tool for downloading waypoints and tracklogs from Garmin units.

Internal Sharepoint

Fire has a page on the parks internal sharepoint site to provide a window to some of the most pertinent documents and maps. Maps are available via the Maps tab on the parks internal sharepoint.

Internal Web mapping

The GIS staff has created several web maps for other park staff to view GIS data without the need to install special GIS software. A webmap specific to the fire program has been created and the location is available via the sharepoint page for Fire or from the Maps tab (see SEKI Fire on the Web). Map information such as planned fires, current fires, fuels, vegetation, fire return interval departure, national fires (via Geomac services) are available to SEKI fire managers from their web browser.

Internet

Public access to key fire information and data through the Internet is crucial to educating the public about the fire and fuels management process. Information on the status of the parks' fire program can be reached through the main NPS website for SEKI (www.nps.gov/seki). The parks also publish several geo-spatial databases, including fire data, to the NPS Data Store IRMA (Irma.nps.gov) that is publicly available.

National NPS Fire SDE Database

SEKI provides data to the NPS National Fire Geospatial SDE database housed in WASO. Each year as the parks' collect fire history, the perimeters that are mapped are loaded into the PWR version for reconciliation by the regional fire GIS Specialist. These must be cross-linked to the Point of Origin which is an export from the WFMI database. Other layers that are posted to the national SDE include thinning segments fire management units (FMU's), and Wildland Urban Interface (WUI) areas.

FFI Data

The parks FFI (Feat Fire Monitoring) databases have been migrated to the SQL Server so that backups and user administration can be accomplished in one location. Since the databases were upgraded to SQL Server 2008 R2 fire effects monitors cannot run in the standalone version of FFI unless the user installs this version of SQL Server on their machine. Administration of the FFI databases, backups, and user access is handled by the GIS Administrative staff.

TRAINING

GIS Staff

GIS data management staff need to keep abreast of the latest technologies in computer software and interagency standards that apply to fire mapping in support of operations and planning.

Other Park Staff

At least one training class in ArcGIS is provided every other year to park staff by the GIS data management staff. GPS training has also been provided on an as-needed basis. Additionally, the GIS staff have provided updates to park staff on various ArcGIS tools, such as using the SDE, that improve the efficiency of data access. Many items of GIS training interest can be found on the parks' internal sharepoint Maps tab.

EXISTING DATA

Fire data is integrated into parkwide strategies for managing data. A file directory structure standard was completed in 2000, as part of the Sierra Nevada Network Data Management Plan development, with the purpose of standardizing the organization of documents, databases, imagery, and geospatial data in a distributed client-server environment. Additionally SEKI puts a published version of master GIS data in the Spatial Database Warehouse (SDE). This SDE is built on a SQL Server interface for GIS data that allows for replication, easy backup, and multi-user versioning, and serving through web maps.

GIS Data

Format and Projection

All geospatial data is currently projected in the UTM coordinate system using the NAD83 datum in Zone 11. Data are available in shapefile, Geodatabase, SDE, and Grid formats.

Existing park data

Park fire and other GIS data can be found on the Spatial Data Warehouse or SDE database. Some data is also available on the internet at the NPS IRMA portal (Irma.nps.gov).

Base Cartographic Data

The Fire GIS Specialist is involved with several projects to develop and maintain other supporting cartographic data, such as building locations, roads, air hazards, etc.

Fire GIS

As per RM-18, GIS has been used to look at Hazard, Risk, and Values, along with other analyses deemed pertinent to the fire management staff. These layers are derived annually from existing park data such as vegetation and fire history. The types of data and general processes are described in the "Data Collection and Analysis" section below under "Fire Analysis."

Vegetation mapping

The vegetation map is used as a basis to derive many fire analyses. The parks current vegetation map is based on aerial photography from summer 2001 and was completed in January 2007. Additionally, the parks have collaborated with the U.S. Forest Service to use common crosswalks so that seamless vegetation data is available for fire modeling in their CALVEG tile system.

Farsite

Park geo-spatial data has been processed into Farsite landscape files. These data are updated on an annual or as-needed basis and made available on the parks' network data server. CD-ROMs are also available for Farsite data.

WFMI Data and Ignition Locations

DI-1202 forms are entered into the Boise WFMI system for all wildland fires. This data is retrieved after the end of the year, via extract from the WFMI website, and used to populate GIS tables for fire history. Currently two separate sets of tables are maintained for fire ignition locations, one by GIS and one from the 1202 system. A project was undertaken by the fire GIS Specialist to validate the existing GIS database with the WFMI 1202 database. By maintaining fire ignition locations separate from WFMI, GIS can validate the locations in WFMI. Some location errors persist due to the workflow from field staff to GIS to data entry staff. We will be looking at methods to reduce this in the future.

Plot Data

Plots come from a variety of sources and have multiple purposes including fire effects monitoring, fuels monitoring, and fire research. Plot locations are geo-referenced. Associated tabular data is stored on the park network server in the appropriate format and can be cross-linked to the geospatial plot locations. Data management of these tables is handled at the park level or at the program level.

DATA COLLECTION AND ANALYSIS

Fire Occurrence

Fire Locations and Verification

Fire locations are reported to fire dispatch in Latitude/Longitude format w/ decimal minutes (i.e., DD MM.99) or UTM. Point locations given on the Fire Report (1202) may not prove to be accurate when placed on a topographic map. GIS will be used to increase the accuracy of fire ignition locations by providing a map of the point location given. The burn boss or incident commander will verify this location. GIS will maintain the point database on the central server and include these locations on maps provided. Fire staff should use the most recent mapped location for the 1202 report.

Fire Size and Digitizing

Fires < 10 acres – Fires less than 10 acres will be captured as point locations and entered into the central GIS database. These points will be buffered into polygons later in the fire history update process. An exception may be made to digitize the actual area if it is determined that this area's location may play a significant role in monitoring (i.e., cheatgrass). All fires will originate as point locations.

Fires ≥ 10 acres – Fires greater than/equal to 10 acres will be digitized from the 7.5' quadrangle drawing, or from GPS tracks gathered at the fire site, either on the ground or from air reconnaissance. The perimeter will be shown on a map for the 1202 fire report. 7.5' topographic maps should NOT be shrunk or enlarged – when possible, submit the original topographic map to GIS for digitizing.

GPS – Where feasible, fire perimeters should be gathered via GPS. This reduces inaccuracies and saves time digitizing.

Fire History

Fire history in the parks was originally compiled through the process of researching and digitizing old maps. There are several types of these old maps. The GIS office produced a set of topographic maps that were used as the original base maps for digitizing into GIS. The Fire Management Office retained a set of maps collectively known as the fire atlas. Both of these sets of maps have been moved to the museum archives. The individual fire records are also located in the museum archives. Currently, fire history is updated digitally by following the processes listed above. This and other GIS processing protocols are documented on the internal server in the share_docs/GIS/protocols/fire location.

Prescribed Fire Planning

GIS layers are derived each year for prescribed burn planning outlining the planned ignitions for the coming year as well as the future five year plan. These are available via the SEKI Fire web map application and as separate GIS layers.

Fire Analysis

Several types of fire analysis are processed in the early spring following the compilation of fire history from the previous calendar year. Stored with each of these datasets is a processing protocol document available for GIS technicians.

Fuels

A fuels layer is derived by reclassifying vegetation and modifying it based on fire severity and history. Working with an interagency group and the NPS regional fuels specialist, the crosswalks have been completed for the new vegetation map. Currently the parks are using the 40 Scott and Burgan models. The fuels layer is updated each year by following a fuels succession model developed in conjunction with Yosemite. The results of the model have yet to be field validated.

Hazard

A hazards layer is derived using Flammap outputs. The flammap typical run for this is to use 10mph uphill winds and extreme fuel moistures to simulate the worst case scenario.

Risk

Risk data has been created from fire history by generating a point ignition file from either the reported fire start location, or a location derived by GIS from the center point of the GIS database location. The point ignition data can then be categorized into types of risk, such as lightning risk or human-caused ignition risk.

WFDSS

The parks' contribute several data layers to the national WFDSS website for managing SEKI fires. These include fire management units, planning areas, and management action points.

Fire Return Interval Departure

This process, locally known as FRID (Fire Return Interval Departure) was also developed by fire ecologists and the GIS staff. It uses fire history and the estimated historic fire regime to reclassify vegetation. The known fire history year is subtracted from the current year giving the number of years since fire. This is then compared to the historic fire return interval to determine how much an area has deviated from the return interval. This is a significant planning tool for locating fuel buildup. GIS can identify locations of concern for field reconnaissance.

Knowledge of Historic Fire Regime

Knowledge of historic fire regimes in the parks is an ongoing research project. The fire ecologist has compiled a table from intensive research using tree-ring samples and historic documents. This table is the crux of the fire analysis process. It projects an estimate of the historic fire return interval for each vegetation type in the parks. The current focus of research is distinguishing between fire history on different slope aspects. The results of this research will allow the fire management program to refine its estimate of fire return interval departure.

Landscape Treatment Priority Analysis

By combining several of the analyses listed above, the parks have developed a process to help identify treatment priorities. Hazard, Risk, FRID, Wildland Urban Interface, and the presence of giant sequoia groves are all part of the inputs into this analysis.

Burn Severity

The parks submit a request each year to the USGS's EROS data center to provide burn severity data from Thematic Mapper satellite imagery. The data is fairly course (30 meters pixels) and has difficulty picking up changes in heavy canopy. The fire effects crew reads CBI plots to validate the burn severity data. High and moderate burn severity areas are being used to update the fuels and canopy cover layers. The EROS data center also completed a more comprehensive fire history spanning the depth of the landsat dataset to look at burn severity history for over 20 years.

RESOURCE ADVISOR SUPPORT

The Fire GIS Specialist processes data from several sources to compile a set of maps for Cultural, Natural, and Physical resources. These are then used by the parks' Resource Advisors (READs) to assist the fire program with identifying potential resource impacts in the event of an ignition. Resource Advisors have access to the maps via the parks' sharepoint site and READs have been provided with encrypted and password protected thumbdrives with the map data in geopdf format so that they have easy access to these resources while on call and potentially away from their offices.

INTERAGENCY COLLABORATION

The need for fire managers in the southern Sierra Nevada to work collaboratively is increasing. Informed decisions require information on the current status of fires across the regional landscape. As a matter of standard practice the Fire GIS Specialist and the Fire Planner collaborate with other agencies for data development and coordination.

Statewide Fire History

The parks have participated in the statewide fire history database maintained by the California Department of Forestry and Fire (CalFire). With the advent of the NPS National SDE layer the statewide database is now populated via the PWR fire GIS Specialist who pulls data from the entire region to submit to CalFire. This is usually completed in late spring.

SSFMO/SWFRS

The Southern Sierra Fire Management Officers (SSFMO) group was established to support interagency fire management. The Sierra Wildland Fire Reporting System (SWFRS, http://sierrafire.cr.usgs.gov/swfrs) is a web based application whose goal is to provide fire managers with a dynamic, web-based reporting and mapping system identifying the locations of and current status of fires in near real-time. Specific goals identified include:

- Provide interactive maps displaying the current fire situation with robust summary report capabilities.
- Display remote web cam images and links to smoke monitors in the region. This has become an important tool in support of our relationship with the air district.
- Minimize redundancy with other fire management applications.

The SSFMO group includes five national forests (Humboldt-Toiyabe, Inyo, Sequoia, Sierra, & Stanislaus), two national parks (Sequoia & Kings Canyon and Yosemite), and the Bakersfield Field Office of the Bureau of Land Management.

G - Organization Charts

Since the fire and fuels management program is comprised of staff members in different divisions, seven organization charts are necessary to describe the organizational structure:

The following organizational charts are included:

- Sequoia and King Canyon National Parks
  - Division of Visitor, Fire and Resource Protection
    - ✓ Kings Canyon District
    - ✓ Sequoia District
    - ✓ Fuels Management
  - Division of Interpretation, Education, and Partnerships
  - Division of Resources Management and Science

Figure G-1: Organization Chart for Sequoia & Kings Canyon National Parks

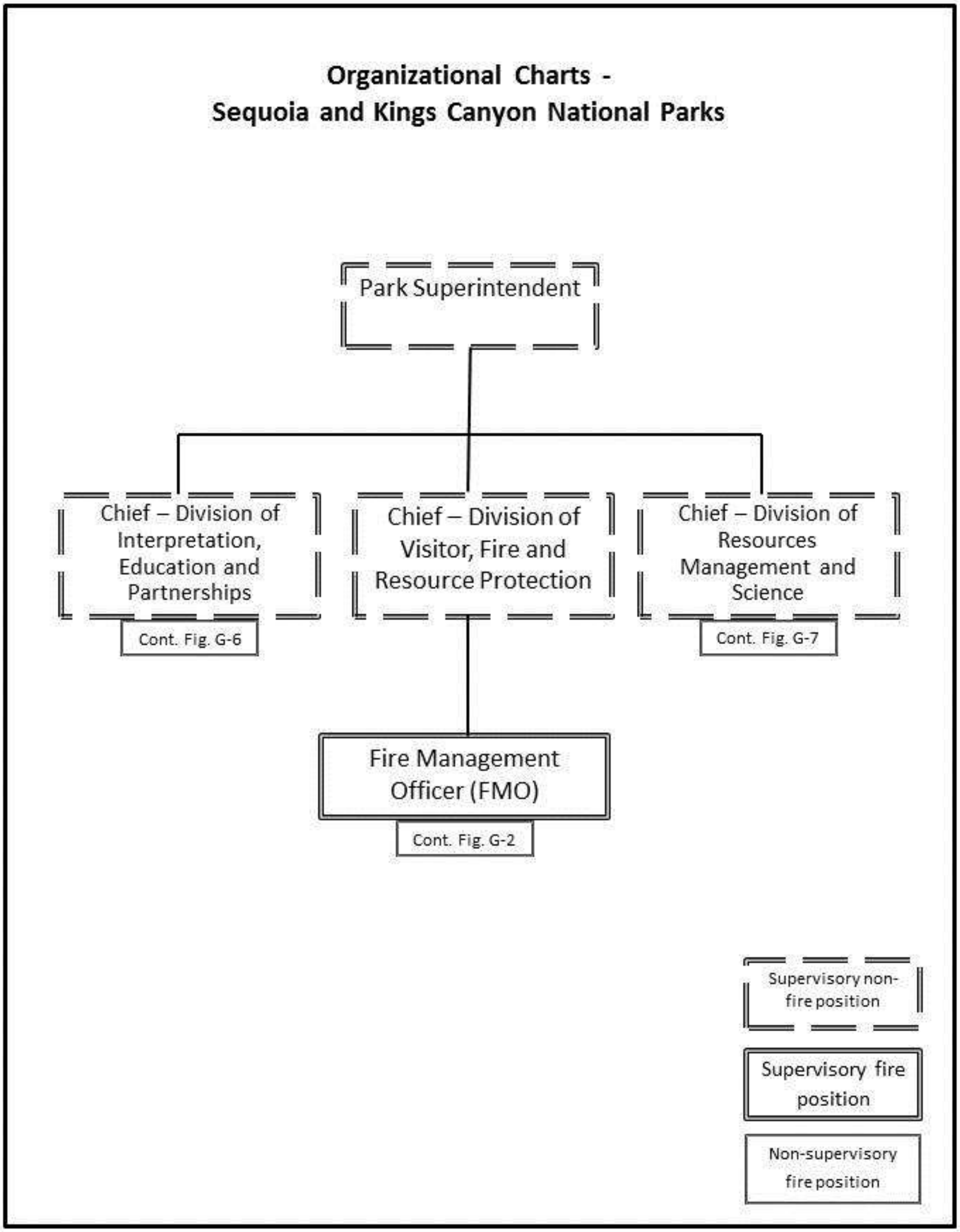


Figure G-2: Organizational Chart for Division of Visitor, Fire and Resource Protection- Fire Management Level

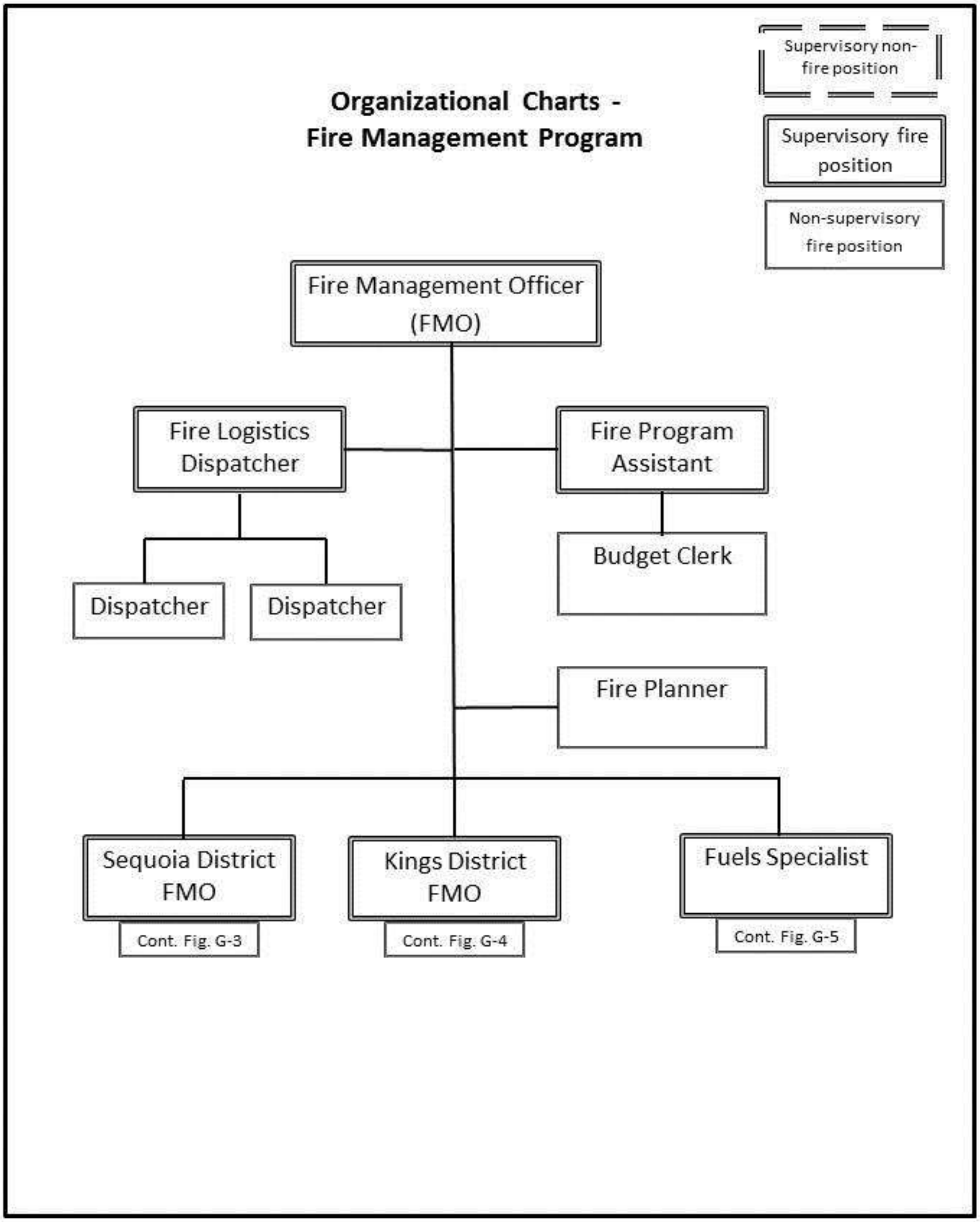


Figure G-3: Organization Chart for Sequoia District

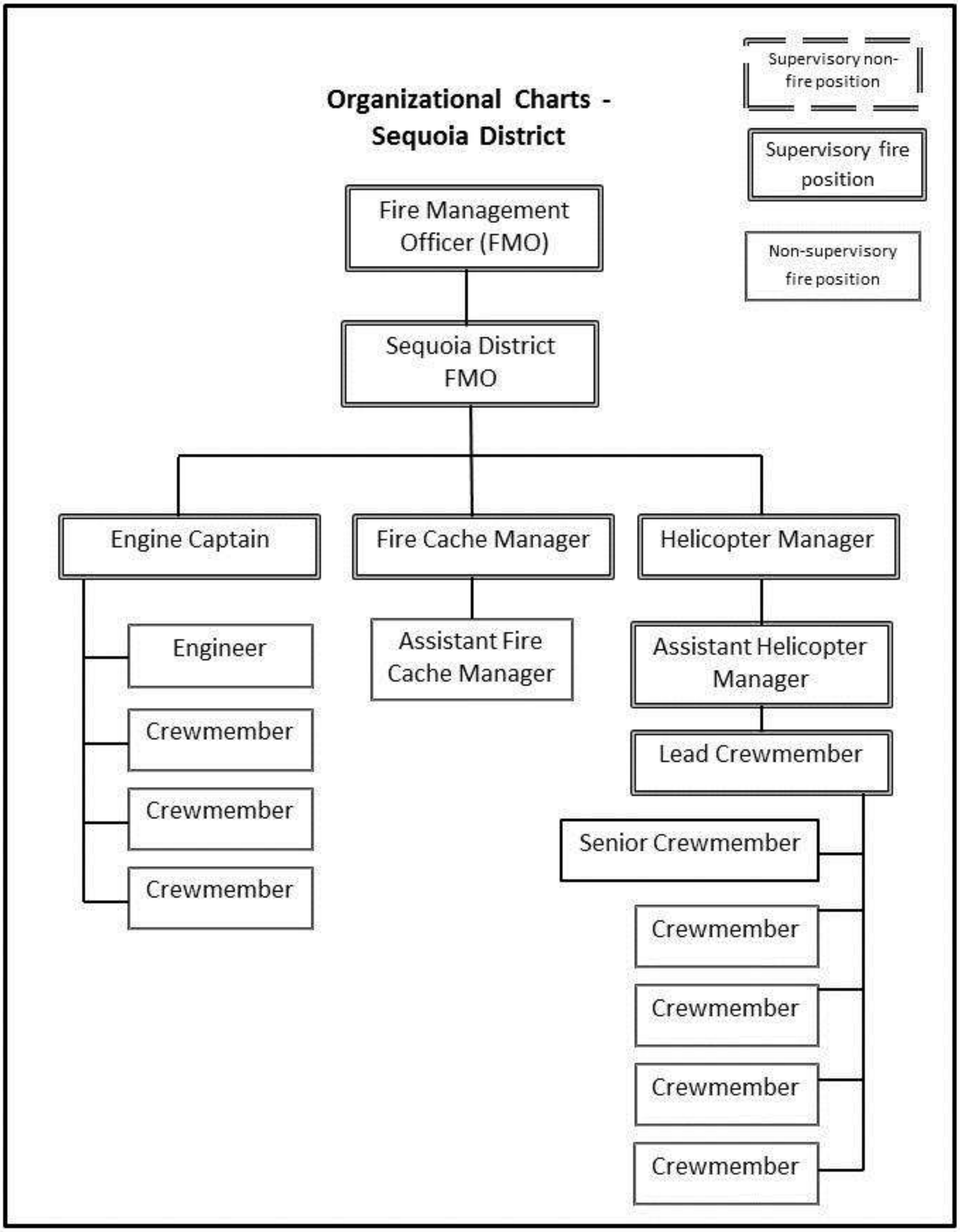


Figure G-4: Organization Chart for Kings District

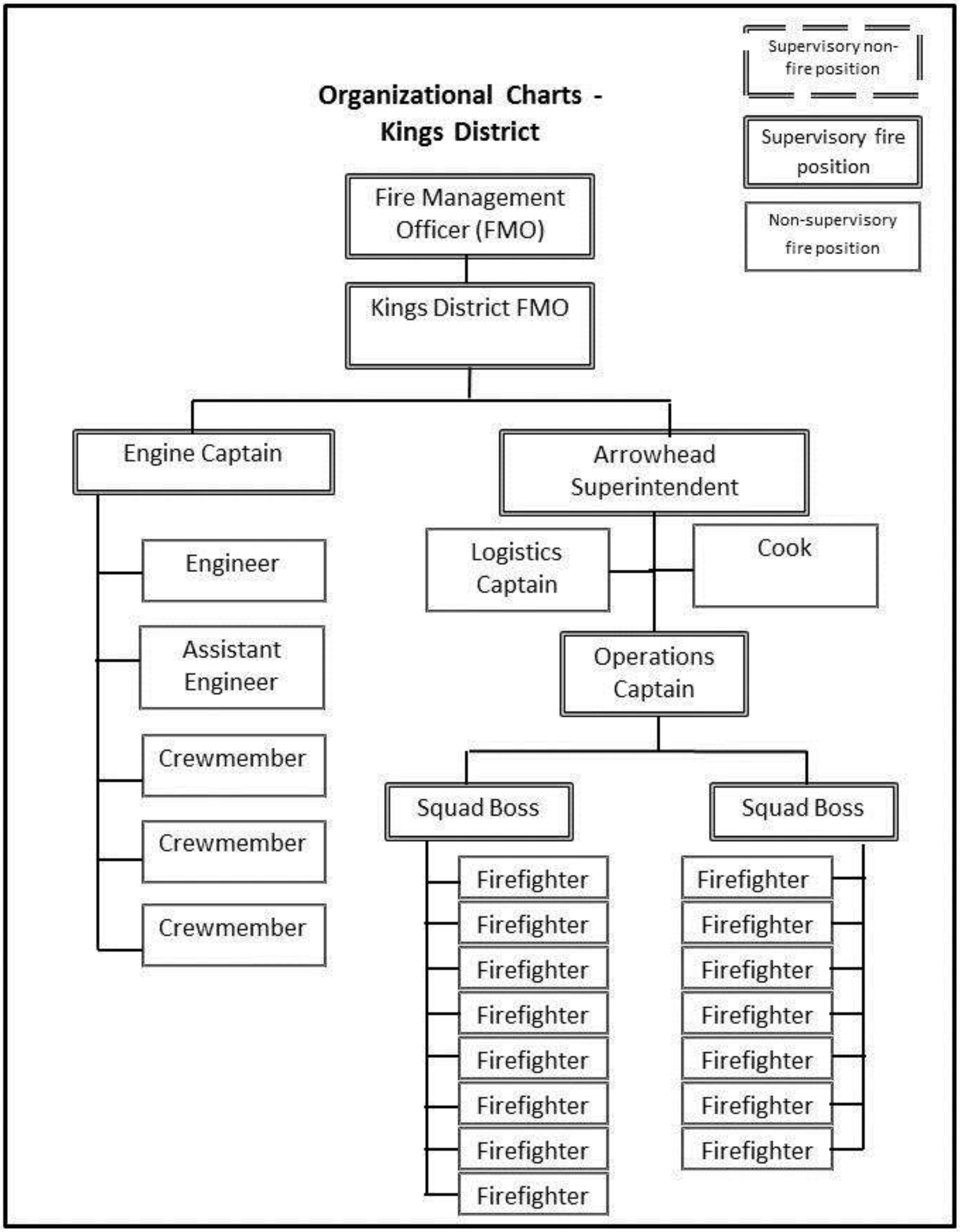


Figure G-5: Organization Chart for Fuels Management

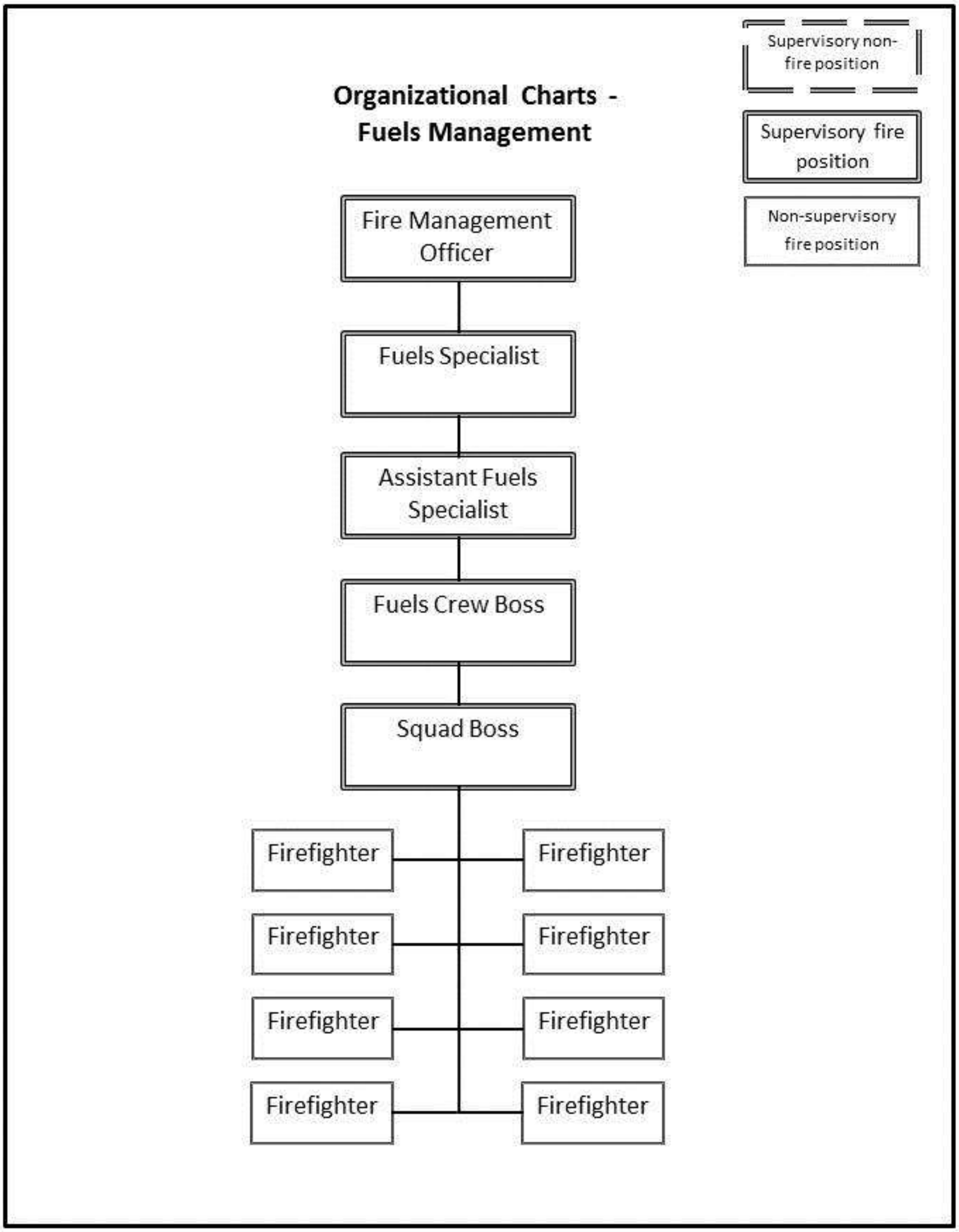


Figure G-6: Organization Chart for Division of Interpretation, Education and Partnerships

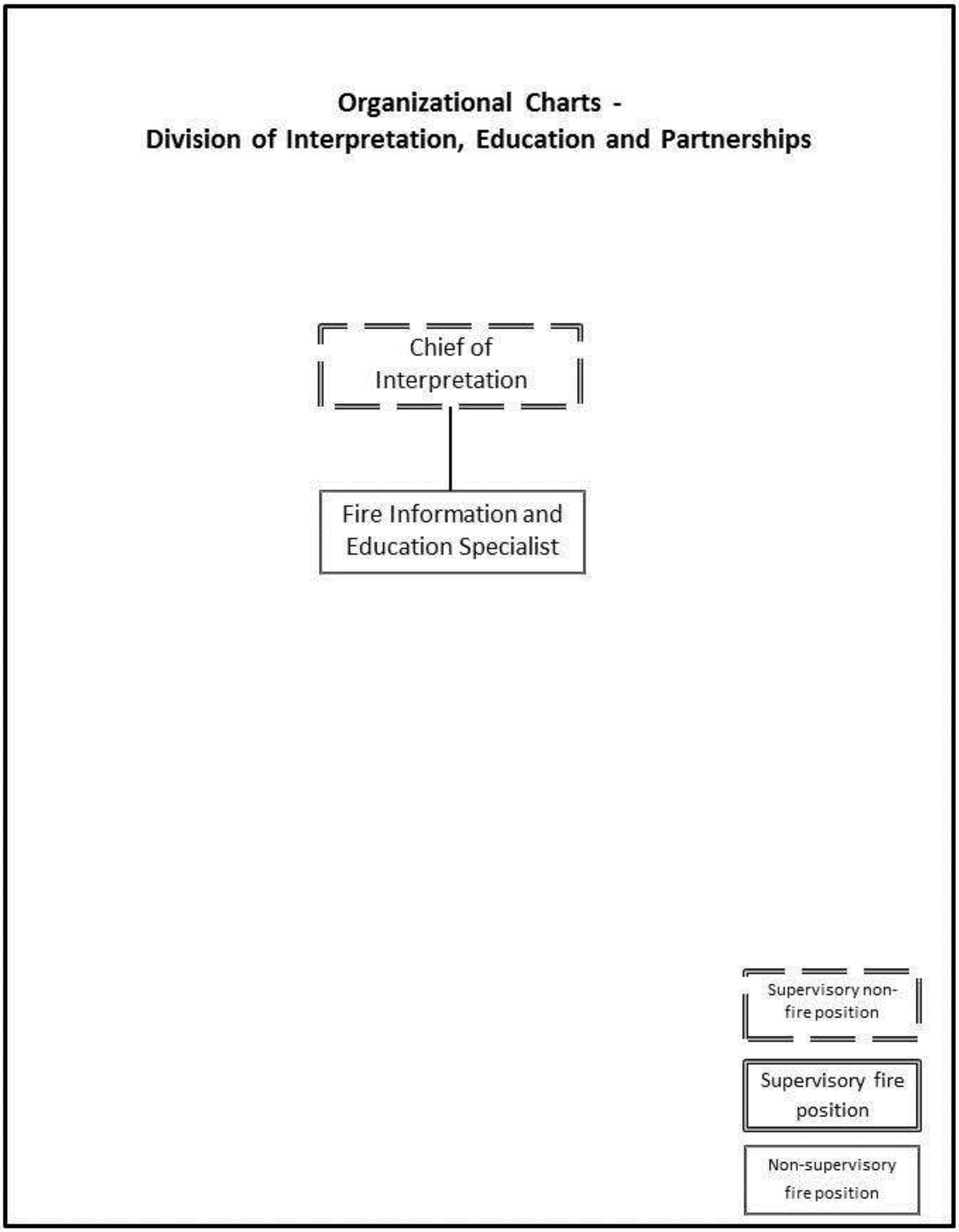
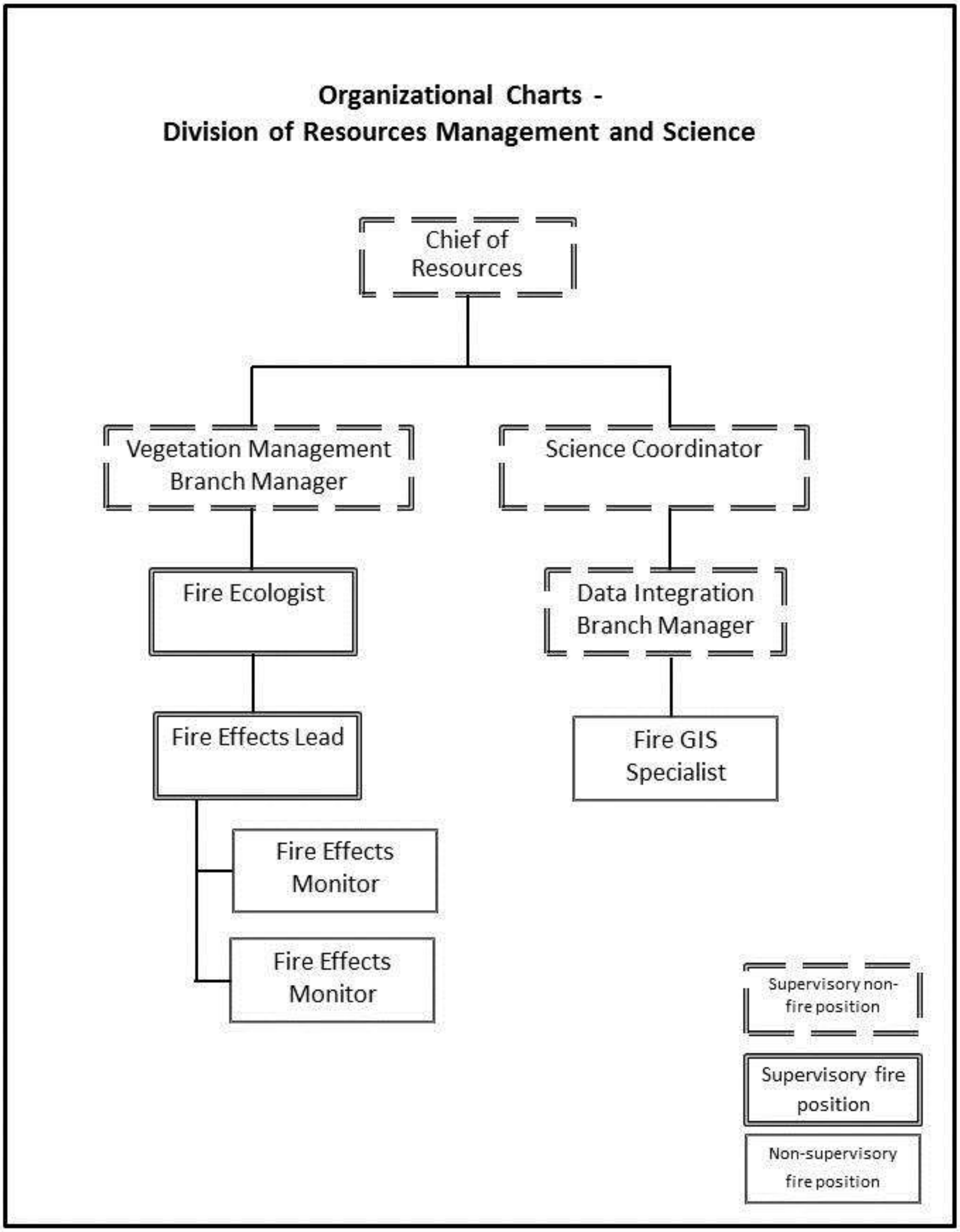


Figure G-7: Organization Chart for Division of Resources Management and Science



H - List of Classified Structures

DEFINITION: The List of Classified Structures (LCS) is defined by the National Park Service (NPS) as an evaluated inventory of all historic and prehistoric structures that have historical, architectural, and/or engineering significance within parks of the National Park System in which the NPS has, or plans to acquire, any legally enforceable interest. The list is evaluated or "classified" by the National Register of Historic Places criteria. Structures are constructed works that serve some form of human activity and are generally immovable. They include buildings and monuments, dams, millraces and canals, nautical vessels, bridges, tunnels and roads, railroad locomotives, rolling stock and track, stockades and fences, defensive works, temple mounds and kivas, ruins of all structural types that still have integrity as structures, and outdoor sculpture.

Park structures on the LCS should be afforded every reasonable effort to be preserved and maintained within the confines of firefighter and public safety. Although little may be known about some of the listed structures and the subject matter expertise and associated funding to classify and preserve some of them may be limited, that does not preclude their historical and cultural significance nor the parks' obligation to ensure their protection.

NOTES: Gray signifies that the structure is in designated wilderness and is listed on the National Register of Historic places.

Bold outline signifies that the structure is in designated wilderness and has not been listed on the National Register of Historic places.

Table H-1: List of Classified Structures (LCS) as of 2013

LCS Structure Name	Park No.	LCS No.	Condition
83681 President's Lane	C-108	377906	Fair
83690 Park Road (Cabin / Lookout)	C-91	377868	Fair
Alles Cabin	007A	9501	Poor
Ash Mountain Administration Building	AM1205	679770	Fair
Ash Mountain Carport for Residence #6A and #17A	AM1636	679821	Good
Ash Mountain Entrance Sign	HS-009	5030	Good
Ash Mountain Fire Control Building	AM1201	679735	Good
Ash Mountain Garage for Residence #10	AM296	57662	Good
Ash Mountain Garage for Residence #11	AM297	679696	Fair
Ash Mountain Garage for Residence #12	AM298	56410	Good
Ash Mountain Garage for Residence #132	AM328	679725	Good
Ash Mountain Garage for Residence #14	AM300	57663	Good
Ash Mountain Garage for Residence #15	AM301	59694	Good
Ash Mountain Garage for Residence #29	AM302	679716	Good
Ash Mountain Garage for Residence #9	AM295	56404	Good
Ash Mountain Garage for Residence #95	AM310	57531	Good
Ash Mountain Garage for Residence #96	AM311	57554	Good
Ash Mountain Garage for Residence #97	AM289	57583	Good
Ash Mountain Garage for Residences #5 & #7	AM292	56377	Good
Ash Mountain Garage for Residences #63 & #64	AM303	56488	Fair
Ash Mountain Garage for Residences #77 & #78	AM304	57518	Good
Ash Mountain Garage for Residences #87 & #88	AM305	57520	Good
Ash Mountain Garage for Residences #90 & #91	AM306	57523	Good
Ash Mountain Garage for Residences #92 & #104	AM307	57526	Poor

Ash Mountain Garage for Residences #93 & #94	AM308	57528	Good
Ash Mountain Gas Station	AM168	57613	Good
Ash Mountain Maintenance Building	AM1295	679805	Poor
Ash Mountain Residence #104	AM104	57584	Good
Ash Mountain Residence #12	AM12	56407	Good
Ash Mountain Residence #131	AM131	679565	Good
Ash Mountain Residence #132	AM132	679604	Good
Ash Mountain Residence #14	AM14	57664	Fair
Ash Mountain Residence #15	AM15	59693	Fair
Ash Mountain Residence #16	AM16	59695	Fair
Ash Mountain Residence #29	AM29	56486	Good
Ash Mountain Residence #5	AM5	56376	Good
Ash Mountain Residence #63	AM63	56487	Good
Ash Mountain Residence #64	AM64	56489	Good
Ash Mountain Residence #7	AM7	56378	Good
Ash Mountain Residence #77	AM77	57516	Fair
Ash Mountain Residence #78	AM78	57517	Good
Ash Mountain Residence #87	AM87	57519	Good
Ash Mountain Residence #88	AM88	57521	Good
Ash Mountain Residence #9	AM9	56385	Good
Ash Mountain Residence #91	AM091	57524	Poor
Ash Mountain Residence #92	AM92	57525	Good
Ash Mountain Residence #93	AM93	57527	Good
Ash Mountain Residence #94	AM94	57529	Poor
Ash Mountain Residence #95	AM95	57530	Poor
Ash Mountain Residence #96	AM96	57532	Good
Ash Mountain Residence #97	AM97	57555	Good
Ash Mountain Residential Area Rock Structures	tbd	58112	Fair
Ash Mountain Storage Building	AM161	679681	Poor
Ash Mountain Tennis Court	tbd	679830	Fair
Ash Mountain Warehouse	AM1202	679750	Good
Atwell Mill Cold Cellar	tbd	712854	Good
Atwell Mill Ranger Station	62	56085	Good
Atwell Mill Ranger Station Garage	315	56086	Good
Atwell Mill Steam Engine	HS-007	5031	Good
Atwell Mill Stone Masonry, Retaining Walls & Steps	tbd	793521	Fair
Azalea Camp Comfort Station	257	372839	Good
Barkman Cabin	C-25	377763	Fair
Barkman Shed	C-24	377650	Fair
Barton-Lackey Cabin	HS-016	6046	Good
Brown House	C-31	377793	Good
Buckeye Residence #1401	AM1401	679855	Good
Buckeye Residence #1403	AM1403	679867	Poor
Buckeye Residence #1404	AM1404	679877	Good
Buckeye Residence #1405	AM1405	679887	Poor
Buckeye Residence #1406	AM1406	679898	Good
Buckeye Residence #1409	AM1409	679909	Good
Buckeye Residence #1412	AM1412	679919	Poor
Buckeye Residence #1414	AM1414	679931	Good
Buckeye Residence #1415	AM1415	679944	Good
Buckeye Residence #1417	AM1417	679956	Good

Buckeye Residence #1419	AM1419	679967	Fair
Buckeye Residence #1420	AM1420	679978	Good
Buckeye Water Tank	tbd	679989	Good
Bulkley Cabin	C-51	377837	Good
Cabin Cove Cabin #2	HS-113	378119	Good
Cabin Creek Dormitory and Garage	66	5033	Good
Cabin Creek Ranger Residence	65	5032	Good
Cattle Cabin	46	1300	Fair
Cedar Grove Ranger Station	118	6041	Good
Cedar Grove Storage Shed	276	56298	Fair
Chief Ranger's Horse Barn	344	59676	Poor
Cloud Canyon Shorty Lovelace Cabin	HS-18	9472	Fair
Clover Creek Bridge	HS-014	5027	Good
Cold Springs Automotive Water Trough	HS-105	712839	Fair
Colony Mill Road	HS-028	9506	Poor
Crowley Canyon Shorty Lovelace Cabin	HS-026	382217	Poor
Crystal Cave Barrier Gate	D	58113	Good
Crystal Cave Comfort Station & Generator Room	199	58116	Fair
Crystal Cave Trail	F	58117	Good
Crystal Springs Comfort Station	252	372829	Good
Gamlin Cabin	350	1301	Good
Gardiner Creek Shorty Lovelace Cabin	HS-024	9508	Poor
Generals Highway	HS-107	57645	Good
Giant Forest Museum	HS-106	56084	Good
Giant Forest Village Comfort Station	179	5029	Good
Grant Grove Chief Ranger's Residence	108	6038	Good
Grant Grove Generator Building	209	372810	Fair
Grant Grove Horse Barn	246	372542	Fair
Grant Grove Lodge Bath House	GG-Bath	372506	Good
Grant Grove Lodge Duplex Cottage 1/2	2-Jan	372511	Good
Grant Grove Lodge Duplex Cottage 3/4	4-Mar	375849	Good
Grant Grove Lodge Duplex Cottage 5/6	6-May	375854	Good
Grant Grove Lodge Duplex Cottage 7/8	8-Jul	375755	Good
Grant Grove Lodge Rustic Cabin 310	310	372522	Good
Grant Grove Lodge Rustic Cabin 311	311	375808	Good
Grant Grove Lodge Rustic Cabin 318	318	375818	Good
Grant Grove Lodge Tent Cabin 302	302	372525	Good
Grant Grove Lodge Tent Cabin 303	303	375372	Good
Grant Grove Lodge Tent Cabin 304	304	373793	Good
Grant Grove Lodge Tent Cabin 307	307	375430	Fair
Grant Grove Lodge Tent Cabin 308	308	375446	Good
Grant Grove Lodge Tent Cabin 309	309	373680	Good
Grant Grove Lodge Tent Cabin 313	313	375492	Good
Grant Grove Lodge Tent Cabin 317	317	375787	Good
Grant Grove Lodge Tent Cabin 319	319	375707	Good
Grant Grove Lodge Tent Cabin 321	321	375713	Good
Grant Grove Lodge Tent Cabin 324	324	375720	Good
Grant Grove Lodge Tent Cabin 327	327	375738	Good
Grant Grove Lodge Tent Cabin 328	328	375741	Good
Grant Grove Lodge Tent Cabin 329	329	375748	Good
Grant Grove Log Cabin	GG-09	372529	Good

Grant Grove Maintenance Cabin	243	372561	Good
Grant Grove Maintenance Mess Hall	111	372557	Good
Grant Grove Meadow Camp Rustic Cabin 501	501	372534	Good
Grant Grove Meadow Camp Rustic Cabin 502	502	376750	Good
Grant Grove Meadow Camp Rustic Cabin 503	503	376770	Good
Grant Grove Meadow Camp Rustic Cabin 504	504	376799	Good
Grant Grove Meadow Camp Rustic Cabin 507	507	376814	Good
Grant Grove Meadow Camp Rustic Cabin 508	508	376826	Good
Grant Grove Meadow Camp Rustic Cabin 509	509	376835	Good
Grant Grove Meadow Camp Rustic Cabin 510	510	376842	Good
Grant Grove Meadow Camp Rustic Cabin 511	511	376873	Good
Grant Grove Meadow Camp Rustic Cabin 512	512	376888	Good
Grant Grove Meadow Camp Rustic Cabin 513	513	376903	Fair
Grant Grove Meadow Camp Rustic Cabin 514	514	376917	Good
Grant Grove Meadow Camp Rustic Cabin 515	515	376937	Good
Grant Grove Meadow Camp Rustic Cabin 516	516	376950	Good
Grant Grove Meadow Camp Rustic Cabin 517	517	376963	Good
Grant Grove Meadow Camp Rustic Cabin 518	518	377053	Good
Grant Grove Meadow Camp Rustic Cabin 519	519	377063	Fair
Grant Grove Meadow Camp Rustic Cabin 520	520	377084	Good
Grant Grove Meadow Camp Rustic Cabin 521	521	377110	Good
Grant Grove Meadow Camp Rustic Cabin 523	523	377155	Fair
Grant Grove Meadow Camp Rustic Cabin 524	524	377202	Good
Grant Grove Meadow Camp Rustic Cabin 525	525	377220	Fair
Grant Grove Meadow Camp Rustic Cabin 526	526	377228	Good
Grant Grove Meadow Camp Rustic Cabin 527	527	377241	Good
Grant Grove Residence	114	372553	Good
Grant Grove Residence	116	372565	Good
Grant Grove Residence	113	372584	Good
Grant Grove Residence	117	372794	Good
Grant Grove Residence Garage	323	372575	Good
Grant Grove Stables Piano Cabin	GG-H	372549	Fair
Grant Grove Superintendent's Garage	322	372586	Good
Grant Grove Superintendent's Residence	112	6039	Good
Grant Grove Superintendent's Woodshed	245	372590	Good
Grant Grove Village Comfort Station	251	372473	Good
Grant Grove Village Gas Station	HS-101	372456	Fair
Grant Grove Warehouse and Maintenance Shop	237	56087	Good
Hockett Meadow Ranger Station	75	5021	Good
Hockett Meadow Tack-Storage Room	139	5022	Good
Hospital Rock Automobile Watering Stations	HS-111	58141	Fair
Hospital Rock Stone Steps	HS-112	58144	Good
Hospital Rock Stone Water Fountain	HS-110	58192	Good
Kern Canyon Ranger Station	38	9505	Poor
Kern River Trail Bridge	205	5025	Good
Knapp's Cabin	371	6042	Good
Lewis Camp Irrigation Canals	011A	9502	Fair
Linzmier Cabin	C-11	377510	Good
Lodgepole Comfort Station	218	56162	Fair
Lodgepole Comfort Station & Showers	219	56176	Good
Lodgepole Residence 81	81	56088	Fair

Lodgepole Residence 82	82	56089	Fair
Lodgepole Residence 85	85	56090	Fair
Lookout Point Ranger Residence	80	378111	Good
Lookout Point Ranger Station Garage	316	378116	Good
Lost Grove Comfort Station	231	56200	Good
Marble Fork Bridge	HS-029	13017	Good
Mineral King Road	HS-100	378084	Good
Moro Rock Comfort Station	200	56161	Good
Moro Rock Stairway	HS-013	5026	Good
Muir Hut	355	9510	Fair
Old Giant Forest District Ranger's Residence	55	5028	Good
Pear Lake Ski Hut	204	9474	Good
Pine Camp Comfort Station	248	372877	Good
Quinn Ranger Station	33	5035	Good
Redwood Creek Automotive Water Trough	HS-104	378213	Good
Redwood Meadow Ranger Station	102	5023	Good
Redwood Meadow Tack-Storage Cabin	205	5024	Good
Redwood Mountain Equipment Storage	320	56316	Good
Redwood Mountain Ranger Station	115	56123	Good
Shanab Cabin	C-21	377624	Good
Silliman Creek Culvert	HS-108	58193	Good
Slapjack Creek Automotive Water Trough	HS-102	378205	Good
Smithsonian Institution Shelter	354	5020	Good
Sphinx Creek Shorty Lovelace Cabin	HS-021	382267	Poor
Squatter's Cabin	45	1302	Fair
Sunset Campground Bathhouse	260	376639	Good
Sunset Campground Comfort Station	249	376620	Good
Swale Camp Bathhouse	259	372866	Good
Swale Camp Comfort Station	250	372852	Good
Sycamore Corrals Shoeing Shed / Wash Shed	AM144	679841	Good
Sycamore Village Recreational Hall	AM142	56357	Fair
Sycamore Village Store House	AM140	56353	Good
Sycamore Village Store House	AM141	56355	Good
Sycamore Village Tack & Hay Storage	AM143	56360	Fair
Tharp's Log	44	1303	Fair
Traugers Automotive Water Trough	HS-103	378208	Good
Tunnel Rock	HS-109	58187	Good
Tyndall Creek Shepherd's Cabin	12	9504	Fair
Vidette Meadow Shorty Lovelace Cabin	HS-023	9507	Fair
Wolverton Residence 89	89	56092	Good
Woods Creek Shorty Lovelace Cabin	HS-025	9509	Poor

I - Smoke Communication Strategy

The purpose of this communication strategy is to provide factual talking points about smoke that can be used during prescribed fires, response to wildland fires, and fires occurring outside the park. These points will be incorporated into various communication methods employed by the parks in reference to fire and fuels management (i.e. news releases, public meetings, interpretive programs, etc.). For more information on communication methods, please refer to the Public Information and Education section of Chapter 3 in this document and also the *Standard Operating Procedure for Fire and Fuels Information*.

The key to a successful strategy is targeting the right people (audiences) in the right ways (methods) with the right messages (talking points). During a fire incident, there are specific smoke messages that can be integrated into the general fire information effort.

AUDIENCES

- Superintendent and Division Chiefs
- All employees and their families (including NPS, SNHA, USGS, concessions, and volunteers)
- Park visitors (including in-park visitors, internet visitors, and special groups)
- In-park communities – Wilsonia, Silver City, Mineral King cabins, Oriole Lake
- Neighboring communities – Three Rivers, Badger, Pinehurst, Miramonte, and east side communities including Bishop, Lone Pine, Independence and Mammoth Lakes
- San Joaquin Unified Air Pollution Control District. While the SJVUAPCD maintains regulatory authority over the parks for the Clean Air Act, the Great Basin Air Pollution Control District is also a target audience when smoke from wildfires impacts that basin.

METHODS

During a Fire Incident

Clearly outline the authority given to park supervisors to minimize smoke impacts to their employees. Employees can notify supervisors if they are having adverse impacts from smoke. Alternative work schedules and locations will be arranged where appropriate.

- Hold an Open House/Town Meeting for employees and residents in smoke affected areas.
- Track data from particulate monitors in affected areas. Encourage monitoring early in the incident.
- Provide daily air quality information, which interprets the particulate monitor data.
- Set up a smoke hotline (phone) to handle smoke complaints.
- Leave flyers on employee doorsteps with tips to decrease exposure.
- Post information on current air quality conditions as well as tips to decrease exposure to bulletin boards.
- Disperse information via email, phone messages, websites and social media.
- Use the park webpage as a vehicle for dispersing daily air quality information.

- Provide information on air quality conditions to fire dispatch to be included during the daily weather report.

Year Round Actions

- Incorporate air quality messages into year round public outreach including interpretive programs, public meetings, press releases, etc.
- Offer special air quality seminars or training to help locals understand regional air issues.

SMOKE TALKING POINTS

In addition to general fire messages/information, the following talking points on smoke should be included in public information. Each talking point includes an example of language that might be used in updates, news releases, articles, presentations, etc. The talking points are organized in groups according to when they will be used (i.e. specific times during the year or different types of incidents): Year-round, Early Fire Season, Announcing a Planned Smoke Event, Responding to an Unplanned Smoke Event, and During Long-Duration Smoke Event. These talking points can be seen "at-a-glance" in a chart at the end of this section.

Year Round

Wildland fire smoke fits into a larger regional air quality situation.

Example: "The scenic vistas in the parks, especially in the summer, are highly obscured by regional haze. Haze is caused when sunlight encounters tiny particles in the air. These particles may be the result of either natural events or human activities. According to the local Air District, over 95% of the particulate pollution in our area originates from Central Valley sources (i.e. motor vehicles, industrial fuel burning, manufacturing, and agriculture). Less than 5% comes from wildland fire in the Sierra Nevada" (From SEKI's *"Fire & Fuels Management"* newspaper).

Smoke, like fire, is a natural ecosystem component.

Example: "Is there a bright side to all this talk about smoke? While it is a health concern for humans, plants have adapted to live with smoke just as they have many other natural elements of the environment. Scientists are discovering that some plants might even depend on smoke for their survival. A scientific study looked specifically at the low elevation chaparral plant communities. In the laboratory, scientists exposed various seeds to heat and charring similar to what they would experience in a fire and discovered that certain species seeds remained dormant. When the same seeds were exposed to smoke, germination occurred. While some plants, like the giant sequoia, use heat from fires for seed dispersal, it now appears that other plants rely on smoke for germination" (From SEKI's *"Story of Fire"* newspaper, out of print).

Visitors, residents, and gateway communities should expect to see smoke in Sequoia & Kings Canyon National Parks at any time, but particularly in the late summer and early fall.

Example: The southern Sierra is one of the most fire-prone ecosystems in the US. Fire is a reality here and fire managers attempt to restore and maintain fire in a safe manner that bests benefits the ecosystem. This also prevents large, unwanted fires that maybe destructive to the ecosystem and lead to more significant smoke events.

Example: "Regional haze and localized smoke from fire was historically part of the Sierra Nevada viewscape. Historically, lightning fires that spread naturally burned through the late summer and early fall months. These fires would slowly smolder with the cooler and shorter days and eventually be extinguished by rain or snow, known as a season ending event.

Example: "Fire managers in Sequoia & Kings Canyon National Parks take advantage of natural lightning fires in an attempt to restore the natural fire cycle and fire regimes in the parks. Smoke from these fires will likely be visible from certain locations in the park, particularly in the late summer and fall. The fall months provide excellent prescription windows for fire managers to complete projects that meet the desired community protection and ecological goals of the park."

Early Fire Season

Park managers are sensitive to smoke impacts for visitors and employees.

Example: "The Sequoia and Kings Canyon fire and fuels management program is committed to balancing the needs of park resources and people. While fire has always been a natural part of this ecosystem, our current society presents unique conditions. Today, there are more people than ever living near or visiting Sequoia and Kings Canyon National Parks. Every fire management action considers this fact when determining incident objectives."

The parks work closely with the San Joaquin Valley Unified Air Pollution Control District to balance the fire and fuels management program with health and visibility issues.

Example: "The Air District is currently classified as "Serious Non-Attainment" for both ozone and PM-10. To help the district achieve the National Ambient Air Quality Standards, Sequoia and Kings Canyon National Parks burn during optimal weather conditions, utilize optimal ignition techniques, estimate project emissions, project the anticipated smoke plume path, provide extensive public education/awareness, and coordinate with neighboring land management agencies and air districts."

There are ways for park residents and neighbors to reduce their exposure to smoke.

Example: "Smoke concentrations can be avoided by following a few simple suggestions. Close windows, doors, and outside vents when it is smoky to prevent accumulations indoors. Run your air conditioner if you have one. Keep the fresh air intake closed and keep the filter clean. Ventilate your home and work place during periods of minimal smoke. Avoid physical activities when smoke is dense.

Example: "Residents of communities affected by smoke from wildland fires and prescribed fires are encouraged to practice good health habits. A healthy immune system is the best protection against the effects of smoke. Immune function is enhanced with regular moderate physical activity, good nutrition, hydration, and adequate rest" (From USDA Forest Service publication *Health Hazards of Smoke: Spring 2001*).

Breathing smoke is not healthy for anyone, but some people are at greater risk.

Example: "People with heart or lung disease, such as congestive heart disease, chronic obstructive pulmonary disease, emphysema or asthma are at greater risk. Children and the elderly are also more susceptible to the adverse effects of smoke. These people are advised to use caution and avoid physical activity while heavy smoke is present. Consult with your physician for further guidance. "

Example: "The risks of occasional exposure to fine particulate and other components of vegetative smoke are minimal for healthy individuals. However, elevated levels of smoke that persist for months or years increase the risk of heart and respiratory disease, especially among the elderly and individuals with pre-existing respiratory or cardiovascular illness" (From USDA Forest Service publication *Health Hazards of Smoke: Spring 2001*).

The *Air Quality Index* (AQI) is one tool that helps managers, employees, and visitors quantify daily air quality conditions.

Example: "Established by the Environmental Protection Agency and adopted by the states, the Air Quality Index (AQI) is a tool for reporting daily air quality conditions (based upon a 24-hours average). Using numeric information from sensors like particulate monitors, the AQI tells you how clean or polluted your air is, and what associated health concerns you should be aware of. The AQI focuses on health effects that can happen within a few hours or days after breathing polluted air. You can think of the AQI as a yardstick that runs from 0 to 500. The higher the AQI value, the greater the level of air pollution and the greater the health danger. The Index identifies six conditions: good (0 to 15), moderate (15 to 40), unhealthy for sensitive groups (40 to 65), unhealthy (65-150), very unhealthy (150-250), and hazardous (over 250)." (Park Visitor Centers have wooden exhibits that display this information daily.)

Announcing a Planned Smoke Event

During prescribed burns, fire managers utilize smoke management techniques.

Example: "The entire burn segment is 925 acres, but is split into two sections for smoke management reasons. A fire line has been constructed inside the segment where the fire can be held if smoke production is a problem. The burn boss plans to ignite 30-40 acres per day to minimize smoke output. This will increase the duration of the smoke event but will decrease the ambient level of smoke at any one time."

Due to the deliberate nature of prescribed fire, audiences can be notified prior to the smoke event about what to expect.

Example: "During the week of ignition, visitors traveling through the area will smell and possibly see smoke. Smoke will likely be visible from [specific location]. The smoke will most likely settle in lower elevations during the early morning."

The park has the ability to monitor particulate levels in Sequoia and Kings Canyon National Parks (or nearby communities) during smoke events.

Example: "As soon as the park anticipates a smoke event that may affect people, air quality technicians begin operating a Smoke and Weather Monitoring Module. This mobile unit measures particulate levels in the air. Particulates are solid particles produced by things like vehicle emissions, agricultural activities, and fires. The module records levels every hour and then computes a 24-hour average which correlates to the National Ambient Air Quality Standards (NAAQS) established by the Environmental Protection Agency (EPA). This data is retrieved hourly.

Some characteristics of smoke accumulation are predictable because they are based on daytime and nighttime winds.

Example: "Up-slope or up-canyon breezes occur during the day which will often take smoke into higher elevations. At night, these winds change direction and bring smoke down-slope to the lower elevations."

Some characteristics of smoke accumulation are not predictable since they are dependent on atmospheric conditions.

Example: "With unstable atmospheric conditions, smoke from wildland fires is mostly lofted up to very high elevations where it disperses. When atmospheric conditions are stable, perhaps with an inversion layer, smoke can be trapped at lower elevations.

Small fires prevent larger fires. Therefore smaller smoke events prevent larger smoke events.

Example: Every acre that burns under favorable conditions helps prevent the larger, unwanted fire and its smoke event."

Responding to an Unplanned Smoke Event

Small natural fires have the potential to become large fires.

Example: "Burning in heavy mixed conifer fuels, the newly discovered [*Name*] Fire has the potential to expand across hundreds of acres over the next several months.

There are ways of minimizing smoke from a wildfire without fully suppressing the fire.

Example: "While the park hopes to maximize resource benefits by allowing this fire to spread naturally, managers have at least two ways of reducing smoke in special situations. When safe, crews can install fire line in strategic locations to contain certain areas of the fire. In extreme smoke situations, fire managers can drop water on hotspots. Unlike water drops in suppression actions, these drops are not meant to halt fire movement, but slow it down and reduce smoke."

During Long-Duration Smoke Event

Use all of the talking points above and hold an open house/meeting to respond to community, public, and employee needs.

Example: "The parks recognize that smoke has an impact on tourism and we weigh that into our decision process. However, managing fire in a deliberate manner and determining the best methods to safely keep fire on the landscape for ecosystem health also prevents large destructive fires that may close significant parts of the parks or the entire parks for an extended period during peak tourism. Tourism season is also fire season."

After the Incident

Sequoia & Kings Canyon National Parks appreciate the patience of visitors, residents, and gateway communities during the incident and its associated smoke event.

Example: The fire management program considers smoke management in every step of the program. We know that the mountain communities surrounding the park are affected by our management decisions. We attempt to find a balance in the program that addresses your concerns while also returning natural fire to the landscape to reduce the risk of larger, unwanted fires and to achieve the ecological benefits of natural fire. The parks appreciated your patience and understanding during this period.

Table I-1: Smoke Talking Points At-A-Glance

Year-round	Early Fire Season	Announcing a Planned Smoke Event	Responding to an Unplanned Smoke Event	During Long Duration Smoke Event	End of Season or After a Smoke Event
1.Wildland fire smoke fits into a larger regional air quality situation.	4. Park managers are sensitive to smoke impacts for visitors and employees.	9. During prescribed burns, fire managers utilize smoke management techniques.	15. Small natural fires have the potential to become large fires.	Hold an open house or a public meeting	Sequoia & Kings Canyon National Parks appreciate the patience of visitors, residents, and gateway communities during the incident and its associated smoke event.
2. Smoke, like fire, is a natural ecosystem component.	5. The parks work closely with the San Joaquin Valley Unified Air Pollution Control District to balance the fire and fuels management program with health and visibility.	10. Due to the deliberate nature of prescribed fire, audiences can be notified prior to the smoke event about what to expect.	16. There are ways of minimizing smoke in a fire use project without suppressing the fire.		
3. Visitors, residents, and gateway communities should expect to see smoke in the parks, particularly in the late summer and early fall.	6. There are ways for park residents and neighbors to reduce their exposure to smoke.	11. The park has the ability to monitor particulate levels in Sequoia & Kings Canyon National Parks during smoke events.			
	7. Breathing smoke is not healthy for anyone, but some people are at greater risk.	12. Some characteristics of smoke accumulation are predictable because they are based on daytime and nighttime winds.			
	8. The *Air Quality Index* (AQI) is one	13. Some characteristics of			

	tool that helps managers, employees, and visitors quantify daily air quality conditions.	smoke accumulation are not predictable since they are dependent on atmospheric conditions.			
		14. Small fires prevent larger fires. Therefore smaller smoke events prevent larger smoke events.			

Other Sources of Information

- Local Air District
- Air Quality Specialist in the park
- California Air Resources Board Public Education Protocol www.arb.ca.gov/smp/progdev/pubeduc/outreach_protocol.htm
- National Interagency Fire Center – www.nifc.gov
- Environmental Protection Agency – www.epa.gov/airlinks/

Example of Materials

The following list identifies some possible materials for public use. Since most of them predate this *Smoke Communication Strategy*, they serve only as examples and are not templates for this document.

- *Do You Smell Smoke?* or *Where there's fire there's smoke* – General description of where smoke is coming from and some simple steps for reducing exposure.
- *Smoke and Your Health* – Questions and answers about wildland fire smoke and health.
- *Smoke Generated by Wildland Fires* –Describes PM-10, the Air Quality Index, and the use of particulate monitors. (example from SEKI)
- *NPS Using Portable Module for Smoke/Weather Monitoring* –Describes the purpose and operation of mobile monitoring stations. (example from SEKI)
- *Smoke Complaint Log* – Sample sheet for cataloging smoke complaints during a fire event. (example from SEKI)

J - Smoke Management Plan

SUMMARY

This *Smoke Management Plan* provides guidelines for park management of smoke from wildland and prescribed fires. It addresses all requirements set by the San Joaquin Valley Unified Air Pollution Control District (hereinafter called the District).

The parks are within the San Joaquin Valley air basin. The basin is classified as serious non-attainment for the criteria pollutant ozone and non-attainment for the criteria pollutant particulate matter (PM-2.5) as defined by the Federal Clean Air Act. This smoke management plan concentrates upon PM-2.5 as the most immediate pollutant produced by wildland fire.

Under the Clean Air Act and the California Air Resources Board (CARB) State Implementation Plan (SIP), the District is required to implement Best Available Control Measures (BACM) in order to meet established deadlines set for complying with PM-2.5 National Ambient Air Quality Standards (NAAQS). BACM is implemented in the air basin by requiring the parks' fire program, and other burners within the air basin, to comply with a series of emission control measures that are some of the most stringent in the nation. As of May 2010, the District and CARB have approved a PM-2.5 Plan. The Environmental Protection Agency (EPA) has revised its PM-2.5 Plan which will be implemented by December 2014.

In conjunction with other Land Management Agencies, the District has developed *Unified Guidelines and Procedures for Smoke Management* (formerly known as the *Smoke Management Work Plan*) for regulating wildland and prescribed fires. The park *Smoke Management Plan* implements the District plan. In addition, the district has two specific rules pertaining to wildland fires being managed for resource objectives and prescribed fires, Rule 3160 (Prescribed Burning Fee) and Rule 4106 (Prescribed Burning and Hazard Reduction Burning). This *Smoke Management Plan* responds to District procedures and rules contained in their plan. The dynamic nature of air resource management may require annual adjustment to this *Smoke Management Plan*.

The parks are part of an interagency group of wildland fire burners (federal, state, and private) and the District which meets either annually or bi-annually to discuss and seek improvement to basin air quality through improvements in fuels management and associated effects to the air resource. As a group member, the park adheres to all District rules described above.

By carefully managing the timing and location of smoke emissions these parks can meet goals in the *Fire and Fuels Management Plan* and the District's *Unified Guidelines and Procedures* while treating up to 15,000 acres per year of park land. As natural areas are treated and maintained with prescribed fire, wildland fire, and mechanical treatments, the potential amount of smoke emissions will be reduced. Smoke emissions that would otherwise be released during unwanted wildland fire events with accompanying severe smoke impacts to smoke sensitive areas (SSA's), potential harm to life and property, and unnatural alteration of ecosystems will be reduced.

INTRODUCTION TO THE SMOKE MANAGEMENT PLAN

Smoke behavior, and corresponding impacts, is a complex issue involving a number of elements:

- Fuel reduction techniques prior to or instead of burning as a means of emission reduction.
- Amount of fuel loading that will burn.
- Restoration areas have the highest fuel loading, including duff, which mostly burns in the smoldering phase. Maintenance areas have less fuel per acre than restoration areas (including duff loading) leading to a shorter, more discontinuous smoldering phase.
- Location, amount and duration of smoke emissions.
- Type of fire situation and controllability.
- Prescribed burn operations are more controllable and predictable than managing wildland fires for resource objectives. Generally, large unwanted suppression fires are the most uncontrollable and least predictable.
- Time of year smoke is produced.

Summer conditions often provide the best southwesterly flow and lift for smoke but ozone levels are higher. Spring conditions provide weather events to disperse smoke but fuels are often too wet to burn. Fall conditions provide an excellent window for fuel and fire manageability but weather conditions often do not yield good smoke dispersal conditions.

Behavior of the smoke plume, which is dependent on elevation and dynamic meteorological conditions.

Direction and elevation the plume moves and resulting impacts to sensitive airsheds, such as near communities and populated areas and Class I airsheds, such as Wilderness.

Interaction of smoke from park fires with pollution sources in the San Joaquin valley (including other fires in the area).

In 1999, revision to CARB Title 17 forced required changes in District rules. Rule 3160 and 4106, as well as the District *Smoke Management Plan*, arose due to the new Title 17 direction. Rule 3160 describes procedures for assessing fees against acres treated with fire in order to fund District meteorologists and enforcement staff for prescribed fire regulation. Rule 4106 details regulations for permitting, regulating, and coordinating prescribed fire and wildland fires managed for resource objectives within the District area. After the revisions, the District declared the 1997 MOU and its work plan void.

The *Unified Guidelines and Procedures* is now the primary document used as a method to ensure coordination amongst burners and the District.

The current park smoke management program is probably one of the most advanced and complex in the nation. The purpose of the program is to serve the goals and objectives of the park *Fire and Fuels Management Plan* while, at the same time, serve the requirements of the Federal Clean Air Act as enforced by CARB through the District. Beginning in 2004, park fire staff, along with representatives from several land management agencies, worked closely with the District in development of the above mentioned *Unified Guidelines and Procedures*. These guidelines and procedures are reviewed and updated annually by all stake holders.

This plan will be used to provide direction for the parks smoke management program. The plan directly parallels BACM as mandated by the EPA, CARB, and the District. The plan is based on smoke management principals provided by the national fire management training Smoke Management Techniques, RX-410. Written and verbal procedures that implement this plan will be revised continually as new or better methods become available, along with adjustments in staffing and support needs.

Much of this *Smoke Management Plan* details smoke management techniques and administrative procedures. It is recognized that there exists a large amount of potential smoke emissions within the District due to the past 100 years of fire suppression in natural areas. Where lands remain far outside the normal fire regime, unnatural ecosystem structure and processes predominate leading to high fuel accumulations and continuous canopies of vegetation. District staff recognizes these conditions exist and require attention. This plan and District rules and regulations are meant to balance ecosystem needs and air resource needs in order to stabilize ecosystems and reduce the amount of potential emissions over a multi-decade period of time.

REQUIRED DAILY MONITORING

Since 1996, a permanent particulate monitor has been located at Ash Mountain headquarters in Sequoia National Park, near the most populated SSA impacted by park fires, the town of Three Rivers. The monitor is located at the Ash Mountain air quality station. Data (PM-2.5) is collected 365 days per year and catalogued into a database so that baseline particulate loading is produced. Particulate loading for each date can then be compared with historical averages aiding fire managers in comparing current conditions with historical conditions as an aid in prescribed fire treatment and fire use execution.

From 1996 to 2007, the permanent particulate monitor was a TEOM; in 2007 this was replaced with a BAM 1020. Additionally, the park owns and maintains three portable E-BAMs which are strategically placed in SSAs during prescribed fire or wildland fire events.

The park is no longer visually monitoring the impact of transport smoke that flows over the eastern crest into the Owens Valley via the Inyo National Forest.

PRESCRIBED FIRE

Planning: What do we do?

- Annually identify areas that need prescribed fire and/or mechanical treatments by evaluating values, hazards, and risks for the three Zones and nine Fire Management Units (FMUs).
- Select treatment priorities based upon the analysis of the values, hazards, and risks. Consider managerial capabilities to accomplish treatments given practical limitations in planning, finance, operations, and logistical support.
- Write the annual Fuels Treatment Plan that describes the program for the up-coming field season. Insert this annual plan into a revised 5-Year Fuels Treatment Plan. Burns will be dispersed across the parks in order to spread smoke emissions out over as broad an area as possible. Some areas of the park may not have prescribed burns take place every year in order to provide a break from smoke impacting SSA's
- Register the annual Fuels Treatment Plan to the Air District in the spring. Note that air quality regulations and requirements are dynamic and subject to change. Updated procedures and

requirements enacted after the approval date of this plan will be incorporated in annual updates to the Fire and Fuels Management Plan. Air quality concerns remain the major issue affecting prescribed fire treatment.

- In the spring, submit previous year's blackened acreage accomplishment to the District for prescribed and wildland fires managed for resource objectives.
- By June, submit remittance to the District upon receipt of the bill for the previous year's blackened acreage fees per Rule 3160.
- Submit a required Smoke Management Plan via the Prescribed Fire Information Reporting System (PFIRS) for each individual burn to the Air District for review no later than 7 days prior to ignition per the Unified Guidelines and Procedures. While as of 2008 the Air District is no longer reviewing burn plans, they must be made available upon request. Burn plans and Smoke Management Plans will describe the smoke management parameters necessary to provide optimum smoke dispersal based on burn goals and objectives, location, fuel loading and predicted fuels consumption, length of ignition and burn down, and proximity to SSA's. Burn plan contingencies will also include a description of the decision process park management will take to limit smoke impacts if smoke conditions deteriorate in SSA's and the coordination requirements with the District. Minimum safe roadway visibility is described and the mechanism for maintaining safe use of the roads is explained in detail. Smoke management plans will also describe alternatives considered in lieu of burning and earlier treatments employed which have already reduced potential emissions. Discussion will provide why alternatives were rejected and how earlier treatments have provided mitigation for current burning. Emissions will be estimated and included in both documents. Smoke Management Plans must be approved by the Air District before a burn can be implemented.
- Request pre-ignition forecast. Seven days prior to the earliest ignition date, a "Planned Ignition Forecast Advisory" (PIFA) will be submitted to the District to begin long-range smoke dispersal forecasting for the proposed ignition. The District will provide 96-, 72-, and 48-hour outlooks, and 24-hour forecasts on days leading up to the proposed ignition date. The District retains final go/no-go authority until the time of ignition.
- Begin participation in the daily 1300 state-wide smoke coordination conference call seven days prior to ignition. (Usually done by the parks fuels specialist or designee.)

Project Implementation: What do we do?

- Monitor weather and fuels against prescriptive criteria. Prescribed burns are ignited when weather conditions are favorable for dispersing smoke away from SSA's, or during conditions that dilute smoke so that impacts to SSA's do not exceed health standards. This will be accomplished by utilizing the most current and comprehensive weather forecasting information available for predicting smoke transport direction and concentration down wind. Fuel moisture is also a high priority prescription element that will be monitored pre-burn. Fuel moisture prescriptions are designed to provide the optimum balance between the need to moderate fire behavior, minimize undesired fire effects on other resource values, and minimize smoke production (drier fuels burn cleaner and produce less pollutants). Fuel moisture information will be obtained and analyzed pre-burn, primarily focusing on live and dead 1000-hour fuels. One hour fuel moistures will be measured throughout ignition to ensure conformity with the prescription.
- Obtain superintendent go/no go decision on ignition.
- Seek concurrence from the Air District to proceed with ignition.
- Notify the public about the ignition.
- Hold briefing and review burn plan operations with burn staff.
- Ignite a test-fire.
- Make final go/no go decision on ignition (burn boss and associates).

- Ignition occurs. Fire Management staff will proactively regulate the number of acres burned each day. Two factors are of critical importance: emissions produced per day and duration of smoke produced. For prescribed fire treatments of forested areas near SSA's, acreage treated in restoration burns may be limited to about 150 acres per day, with twice that acreage for maintenance treatments. This limit serves only as a guide with acreage treated varying due to terrain, proximity to SSA's, fuel conditions (i.e. loading, dryness, fuel model), meteorological conditions, etc. Duration of smoke produced from fires will vary with the fuel type. Timber fires, due to fuel loading inclusive of duff, burn for the longest time periods. With half the duff present on most maintenance burns, duration is significantly reduced. Again, as a general rule, smoke production near SSA's should be kept to less than five days before significant reduction in particulate load production occurs.
- Monitoring of meteorology and air quality conditions will begin prior to ignition and follow through ignition completion and burn down of remaining available fuels. Qualified fire personnel will conduct all smoke monitoring. This will be accomplished by visual observations on small fires, short duration fires (e.g. grass fires) and on remote wilderness fires. Personnel will monitor smoke impacts to SSA's and transmit that information to the burn boss to utilize the intelligence gathered to adapt burn execution to avoid unhealthful smoke impacts. On fires in close proximity to SSA's, that may be of long duration or possess heavy fuel loading, mobile E-BAM's with a web based data link may be placed in those SSA's for monitoring purposes. A network of web-cams throughout the Sequoia National Forest with a web based data link is also available for park and District personnel to monitor smoke dispersion.
- Dispersion Intelligence. Smoke dispersion potential (the capacity of the atmosphere to absorb and disperse smoke) is carefully evaluated prior to a burn being ignited and during unit execution. Several methods can be utilized:
- Park fire management personnel operate six remote automated weather stations spread across the parks. The weather data collected provides fire staff with current information used in fire operations planning.
- Park fire management personnel operate three portable E-BAM's which can be placed in strategic SSA's to monitor PM-2.5 emissions.
- Standard National Weather Service fire weather forecasts are reviewed for favorable dispersal winds aloft. Generally, ridge winds from the west at 10 to 15 mph are desirable.
- Data provided by various Internet sources provide detailed information on regional weather trends.
- Pre-ignition spot weather forecasts provided by the National Weather Service provide detailed smoke dispersal information. Predicted unstable atmospheric conditions are optimal, although fire managers must weigh instability against the ability of fire behavior to become erratic and escape.
- The District's meteorologists provide additional dispersal information for burns at all elevations.
- The park contract helicopter can be used to assess the atmospheric adiabatic lapse rate before and during burn unit execution--which helps with interpreting the capacity of the atmosphere to disperse smoke. Helicopter crew members also conduct visual observations of burn unit smoke dispersal and record the observations.
- Representative test fires will be conducted prior unit ignition to determine that burning goals and objectives will be met, and that smoke dispersion occurs as predicted in the burn plan.
- Ensure participation in the daily 1300 state-wide smoke coordination conference throughout the ignition phase of the burn by the appropriate individual as designated by the burn boss.

Post-fire: What do we do?

- Report daily acres and emissions to the Air District.
- Assemble monitoring data as part of the final fire package.

- For fires larger than 250 blackened acres, complete District smoke management post fire summary report.
- By June of the following year, pay the current District fee for all black acres produced on the burn.

Staffing Needs and Responsibilities

The park fuels specialist is responsible for the implementation of the annual fuels treatment program and serves as the primary contact with the District. Working with the district fire management officers, he/she will assign burn bosses to individual burn units, who must ensure appropriate staff is assigned to each burn. The park fuels specialist or designee will ensure coordination occurs between the District and the burn boss. Fire and aviation dispatch will track all PIFA and spot fire weather forecasts. During ignition, the park fuels specialist or the appropriate district duty officer will generally serve as the primary point of contact with the District. This will frequently take place during the daily 1300 state-wide smoke coordination conference call. The park fuels specialist will act as the check in the system ensuring coordination at the burn plan/smoke management plan phase, execution phase, and post-fire stage occurs.

Documentation and Cost Tracking

The fire folder will contain copies of all documents as outlined in Appendix P (Prescribed and Wildland Fire Reporting Requirements). The folder will include: all planning documents (burn plan and any amendments, smoke management plans, incident action plans), monitoring data and summary reports, fire time reports, maps, photos, and WFMI reports. All expenditures will be tracked and reported according to the standards established in the Department of the Interior WFMI reports. It is the responsibility of the burn boss, to ensure WFMI report completion. Acres blackened rather than fire perimeter will be used to assess District Burn fees.

WILDLAND FIRES

Planning: What do we do?

When a fire is reported, the parks will take the following actions:

- Locate the fire.
- Size up and determine cause.
- Complete a Response Level 1 document as part of the Wildland Fire Decision Support System (WFDSS) to determine the appropriate management response with eight hours of fire confirmation.
- Per the *Unified Guidelines and Procedures*, notify the District through the Wildland Fire Summary Report Form regardless of size.
- Decision criteria and risk factors to consider in the Response Level 1 are outlined in the Guideline for Implementation of Federal Wildland Fire Management Policy (February 2009). Parameters requiring in-depth analysis for the parks will include air quality for those fires with potential to affect SSA's. If it is determined that the fire can be managed within the constraints outlined, the ignition may be appropriate to manage for resource objectives.
- Implement the appropriate response. For wildland fires managed for resource objectives this may vary from periodic aerial reconnaissance to on-scene fire monitors. If the management complexity

of the fire exceeds the capabilities of local resources, the parks may manage the incident through delegation to a wildland fire incident management team (see Appendix K for a delegation of authority example).

- For fires exceeding 10 acres, complete the District Wildland Fire Smoke Management Summary per the *Unified Guidelines and Procedures*. Most often, smoke management summaries are not needed for those fires requiring only a WFDSS Response Level 1 document because they stay less than 10 acres in size.
- Continue to reassess the fire situation. The park must perform periodic fire assessments. The superintendent must continually validate that the fire is managed appropriately and will assess if there is a need for a more detailed WFDSS Response Level 2 or 3, or a shift to control objectives and suppression actions. If air quality drives the need for a WFDSS Response Level 2 or 3, detailed information on mitigation for air quality effects will be contained in the Response Level document, and cross referenced to the smoke management summary for the wildland fire. If a Response Level 3 is determined to be needed, the park will involve the District in the writing of the smoke management section.
- Manage the fire until declared dead out according to monitoring intensity and frequency guidelines indicated in the WFDSS documents. At the minimum, periodic ground or aerial reconnaissance will be used to verify the periodic revalidation of the wildland fire response. More in-depth monitoring may be necessary to ensure proper incident management if complexity or risk increases. The parks monitor for wind speed, wind direction, smoke plume rise and dispersal, temperature, humidity, fuel moisture, fire size, and fire behavior (rate of spread, direction of spread, intensity).
- The park may request or the District may issue a Fire Emission Dispersion Advisory (FEDA) during times of unfavorable meteorological conditions for smoke dispersal. The FEDA may be used to support strategic or tactical decisions, usually in reference to additional firing for holding actions.
- Ensure participation in the daily 1300 state-wide smoke coordination conference throughout the duration of the fire by the appropriate individual.

Post-fire: What do we do?

- Report daily acres and emissions to the Air District. On wildland fires this may be done weekly or as often as agreed upon with the District.
- Assemble monitoring data as part of the final fire package.
- For fires larger than 250 blackened acres, complete District smoke management post fire summary report.
- By June of the following year, pay the current District fee for all blackened acres produced on the fire.

Staffing Needs and Responsibilities

Response Level 1 through 3 documents will be completed by district fire management officers or their designates (park fire management officer or fuels specialist staff). Additional park staff serving as subject matter experts will be involved in planning as conditions, issues, and fire location dictate. Examples include: district rangers, air quality specialist, archeologist, wildlife biologist, roads and trails supervisor, district facility manager, and fire information and education specialist. Fire complexity and risk will determine staffing needs. The park fuels specialist or the appropriate district duty officer will generally serve as the primary point of contact with the District for the duration of active burning. This will frequently take place during the daily 1300 state-wide smoke coordination conference call.

Documentation and Cost Tracking

The fire folder will contain copies of all documents associated with the fire. The folder will include: all planning documents (Response Level documents and any amendments, smoke management plan, incident action plans), monitoring data and summary reports, fire time reports, maps, photos, and WFMI reports. All expenditures will be tracked and reported according to the standards established in the Department of the Interior WFMI reports. It is the responsibility of the district fire management officer or the fire Incident Commander to ensure fire report completion. Acres blackened rather than fire perimeter will be used to assess District Burn fees.

BURN PLANNING, ADMINISTRATION AND AUTHORIZATION

Fire and Fuels Management Plan. The park's *Fire and Fuels Management Plan* is the primary controlling document that implements NPS fire policy and direction for the fire management program. The plan implements the intent of Director's Order (DO)-18, the National Park Service's wildland fire management guideline.

Annual and Five Year Fuels Treatment Program. An annual and five year Fuels Treatment Plan is completed each year after extensive internal discussions are conducted throughout the parks involving personnel from several park functional divisions. Interagency planning for joint, cooperative burn projects is also completed during the winter and reflected in the annual plan. The annual and five year treatment plan is reviewed by the Fire Management Committee.

Fuels Treatment Planning. Prescribed burns are planned over a broad area to allow projects to be executed during optimum burning conditions throughout the fire season depending on goals and objectives, location, elevation, aspect, fuel type and proximity to SSA's. Mechanical plans and follow-up burning of mechanical fuels are confined to smaller areas associated with maintenance of defensible spaces surrounding structures or communities. Most burns take place above 6,000 feet elevation. All prescribed burn operations must comply with standard park burning prescriptions that include fuel moisture and environmental conditions.

Responsible Park Officials. The Superintendent is responsible for all government activities occurring on parklands, and approves the fuels treatment plans and wildland fires managed for resource objectives. He/she has full authority to act on any fire situation occurring on parklands. The Chief Ranger is supervised by the Superintendent and is responsible for park fire management. The park Fire Management Officer reports to the Chief Ranger, and oversees the planning and operations of park programs relating to fire and aviation management.

RESPONSIBLE PERSONNEL, ORGANIZATION & QUALIFICATIONS

Qualification System. Park Fire Management staff implement DO-18 training and qualifications standards by assuring that fire management personnel are trained and qualified by following the National Incident Qualification and Certification System. The staff works to assure that adequate numbers of qualified personnel are available to conduct prescribed fire and wildland fire operations. Personnel are qualified in the following positions:

- Prescribed Fire Manager - oversees prescribed fire operations program implementation and is supervised by the district duty officer per the SEKI Prescribed Fire Operations Guide (PFOG).
- Prescribed Fire Burn Boss - is responsible for on the ground execution of individual prescribed burns and is supervised by the district duty officer per the PFOG.
- Firing Boss - is responsible for burn unit ignition and is supervised by the burn boss.
- Prescribed Fire Behavior Analyst - is responsible for analyzing potential fire behavior and is supervised by the prescribed fire manager or burn boss depending on incident complexity and need for the position.
- Lead Fire Monitor - is responsible for fire monitoring and is supervised by the burn boss and is responsible for gathering data about fire weather conditions, fuel moisture, smoke dispersal, fire behavior and fire spread and relaying the information to burn incident personnel.
- Firing and holding personnel are supervised by the burn boss and are responsible for igniting the burn segment and holding the fire within established fire lines.
- Incident Commander - is responsible for on the ground execution of individual wildland fires. May be supervised by the district duty officer.

INFORMATION AND AWARENESS

Information about smoke events is distributed to target audiences in accordance with the Public Information and Education section of Chapter 3 in the *Fire and Fuels Management Plan* and the *Standard Operating Procedures for Distributing Fire Information* (Lyle 2002). The latter document contains specific checklists, email lists, community contacts, etc. The Smoke Communication Strategy (Appendix I) provides specific talking points about smoke.

Smoke Complaints Management. Visitor centers and dispatch centers use the *Smoke Information/Complaint Form* to record visitor and employee concerns about fire operations. Information from these forms is immediately transferred to fire managers so that formal complaints can be communicated to the local air district. The forms are collected by the Fire Information Officer and evaluated for special information or outreach needs.

Monitoring and Compliance / Enforcement

On Site. - Smoke monitoring is done on all burns by qualified fire personnel. They monitor smoke impacts to SSA's and utilize the intelligence gathered to adapt burn execution to avoid unhealthful smoke impacts. This is accomplished by visual observations and by use of mobile E-BAM monitors. When used an E-BAM is set-up in SSA's during nearby burn unit execution. The E-BAM records particulate matter (2.5 microns) concentrations. The park has three mobile E-BAMs for this purpose; both of which have a web based data link. A permanent particulate monitor (BAM 1020) is located at Ash Mountain headquarters near the most populated Smoke Sensitive Area impacted by park prescribed burns—the town of Three Rivers.

Off Site. - While the park no longer monitors the impact of transport smoke over the eastern crest into the Owens Valley region, the park does access the network of web-cams managed by the Sequoia National Forest.

The park contract helicopter can be used to conduct visual observations of burn unit smoke dispersal and helicopter crew members record the observations.

Burn Execution Regulation. Individual burn plan smoke management contingencies include a description of the decision process park management will take to limit smoke impacts if smoke conditions deteriorate in SSA's, and are designed to provide outreach to communities impacted by unpredicted smoke or unhealthful smoke impacts.

Notification and coordination with affected air districts occurs on a daily basis throughout the fire season. If there are smoke caused complications during the execution of a fire incident, the affected air district(s) will be notified by phone as soon as practical.

EMISSION INVENTORY

A Fire Management Smoke Emissions Inventory was completed April 19, 1996 per instructions provided by the District for the period 1985 to 1994 and includes projected program through 2010. Annual tracking of actual smoke emissions will be accomplished for prescribed burns and wildland fires managed for resource objectives that are executed during the season

EMISSION REDUCTION TECHNIQUES

Burning Prescriptions. All prescribed burns must comply with standard park burning prescriptions that include fuel moisture and environmental conditions.

Mechanical Reduction Potential. About 98% of parklands are administered as natural areas with about 85% of parklands managed as designated Wilderness. Mechanical techniques to reduce fuel load prior to prescribed burning is therefore limited by law and administrative policy to only the park developed areas. Mechanical fuel reduction is limited to areas immediately adjacent to developments in order to provide protection of structures or infrastructure from unwanted, damaging fire events.

Fuel Moisture. The primary emission reduction techniques used in park prescribed fire operations is to burn forest floor fuels under the "cool" end of the burning prescription, while still meeting burn unit goals, in order to limit the amount of available fuel that burns, thereby reducing overall emissions. Grass and brush fuel types are burned in the "warm" end of the prescriptions in order to produce a cleaner burn--moist grass and brush produces more emissions since the entire plant is consumed by the fire.

STATE OVERSIGHT

The California Air Resources Board (CARB), as the state air regulatory agency, has the authority to enforce all provisions of the smoke management program through the State Implementation Plan.

K - Delegation of Authority Example

Date: *DD/MM/YYYY*

Memorandum

To: *Incident Commander*

From: Superintendent, Sequoia and Kings Canyon National Parks

Subject: *Name of Fire* Delegation of Authority

The Superintendent of Sequoia and Kings Canyon National Parks (SEKI) is responsible for ensuring the protection of park resources and the lives of park visitors and employees. The Superintendent must also act responsibly in dealing with park neighbors. Your expertise in wildland fire management will assist in fulfilling these responsibilities.

Your actions will be guided by National Park Service fire management policy, and Aviation Management Directorate aviation policy. In addition, the portion of the incident on NPS lands will be managed in accordance with the goals and objectives identified in the SEKI Fire Management Plan. To help communicate such policy so that your fire management efforts are successful, we are providing guidelines below:

1. You will have management responsibility for the *Firename* wildfire. A Wildland Fire Decision Support System Document (WFDSS) has been prepared and identifies the Course of Action I have approved. You are responsible for implementing this action. If you are unable to accomplish these objectives or cannot do so within the Management Requirements I have stipulated, you are to notify my Agency Representative or the Parks Fire Management Officer immediately and assist them in updating or preparing a new course of action for my approval.

2. The primary fire related concerns are 1) life and safety, 2) smoke impacts to the local community and the San Joaquin Valley, and 3) destruction of property. Additional NPS concerns include 1) protection of park resources and 2) the potential for fire to spread outside of the park's boundary. The number of acres burned within the acceptable range of fire effects are not of concern. You are to explore opportunities to complete large scale burnout operations under periods of favorable smoke dispersion especially if the burnouts will provide protection and restore the normal fire return interval to Giant Sequoia groves.

3. I recognize that exigent circumstances occur. Therefore, you are authorized to take those immediate actions necessary to stabilize emerging situations until my fire

management team and I can work with you in developing and approving a new course of action.

4. You are required to develop and keep current an incident action plan that includes procedures for managing an "incident within an incident," a medical plan that includes emergency evacuation procedures, safety plan or guidelines, and communication procedures and frequencies.

5. The safety of fire personnel, the public, and our employees is the highest priority during all phases of the incident. It is also important to minimize area closures, to the extent that this does not compromise human safety. To date *describe current status of trail closures*.

6. You will be operating within Wilderness. Environmental impacts from fire management actions are of greater concern than the total number of acres burned. If holding actions must be executed, please use minimum impact suppression tactics (MIST) commensurate with the resource. For example: 1) chemical containing retardant are not applied within 300 feet of any waterbody, 2) fire lines should not be constructed directly through meadows, and 3) all fire lines will be rehabilitated according to agency policy (approved by the chief, resources management).

7. Minimize the possibility for the spread of non-native species into wilderness and other park areas by adhering to Management Directive 38, *Preventing the Introduction and Spread of Invasive Non-Native Plants*. Depending upon the scope of possible actions, I will assign a lead resource advisor to work with you to minimize adverse impacts on the parks' natural and cultural resources.

8. The *Firename* fire has burned *describe general fire location, park resources available to team and relationship between park and IMT resources*.

9. Please give special consideration to the impacts and benefits of your operation to the visitors and employees of *XXXX – describe responsibilities and resources available*.

10. Work with park fire information staff to keep park concessionaires, park and forest visitors, employees, cooperators, and neighbors fully informed of your actions and decisions. Please give us the opportunity to review written materials and news releases pertaining to our unit before dissemination. The Parks' Fire Education Specialist will be available to assist you in accomplishing this objective. Additional educational opportunities may exist in the area. Please work with the Parks' Fire Education Specialist to ensure these opportunities are met.

11. The XXXX is found in your planning area. *Describe any special considerations.*

12. Proper food and scented product storage procedures must be followed at all locations to prevent park wildlife from consuming any human made materials (including trash).

13. Manage costs commensurate with resource values affected.

14. The fire is within the boundary of the San Joaquin Valley Unified Air Pollution Control District. You must work with the parks fire management staff on daily coordination with the Air District. Statewide conference call procedures exist to help with the process.

15. The parks' staff will assist you with your aviation needs in NPS air space and any need you may have for the helispot. Please work with the agency representative in developing your aviation plan.

16. The parks retain fire detection and management response decision analysis except for the area lying within the *Firename* fire planning area. We will keep you fully informed regarding fire response outside your planning area and ask that you do the same for areas within your planning area. We expect full and prompt consultation should additional starts occur.

17. We have fire and aviation personnel assigned to the fire and available for your use. We expect you to work with the Agency Representative so these resources obtain the fire experiences required for career development.

SEKI Park Contacts:

Fire Management Officer - Dave Allen, (559) 565-3160.

Agency Representative – John Ziegler, Kings District Fire Management Officer (559) 565-4337 or John Goss, Sequoia District Fire Management Officer (559)-565-3162.

Resource Advisor – The Division Chief, Resources Management and Science, (559) 565-3120 or the Fire Ecologist, (559)-565-3120.

Fire Information – Fire Information and Education Specialist, (559) 565-3703.

Logistics – Gerry Carder, Fire Cache Manager, (559) 565-3163.

As of *XXXX* hrs on *Date*, we are delegating to you the authority to manage the *Firename* Fire. This delegation will remain in effect until the parks receive a return memorandum from you turning authority for management of the fire back to the parks.

L - Fire Crew Readiness Review

Crew Designator: ________________________

Does the crew meet minimum Redbook qualifications? Yes No

Name and Crew position	Highest Qualification

Have all crew members attended annual wildland fire safety refresher? Yes No

Have all crew members passed arduous duty medical examinations? Yes No

Have all crew members passed the annual pack test? Yes No

Have all crew members completed a fire readiness review? Yes No

Comments: The fire readiness review for local response does not have to be the national review template

I have reviewed the crew's qualifications and certify the crew is available for wildland fire response.

Reviewed by: ______________________________ Date: ________________

Crew Leader

Reviewed by: ______________________________ Date: ________________

Program Manager

Concurred by: _____________________________ Date:________________

SEKI Fire Management Officer

M - Fire Restrictions and Emergency Closures

Closures

Emergency closures can reduce the possibility of human caused wildfires occurring during periods of seasonal drought, when wildfires can cause serious damage to park resources and threaten the safety of park visitors and employees. High fire danger alone is highly unlikely to require that park areas be closed to public entry. Emergency closures for public safety reasons are generally made to limited areas of the park affected by current fire operations.

Objectives

- To restrict the use of fire by the public in defined areas of the parks during periods of high, very high, and extreme fire danger.
- To provide park administrative staff with a procedure for making emergency closures for fire prevention and public safety reasons.
- To develop fire restrictions and emergency closures that comply with the requirements set forth in 36 Code of Federal Regulations, Part 1, section 1.5.

Authority

Fire restrictions and emergency closures shall be made in compliance with the requirements set forth in 36_2 Code of Federal Regulations (CFR), sections 1.5 and 2.13(c). For enforcing fire restrictions, this plan serves as the written determination required in section 1.5 (c). Decision memorandum will be approved by the superintendent when fire restrictions are enforced. For enforcing emergency closures for fire prevention or public safety reasons, a Special Order will need to be approved by the park superintendent and given wide distribution. Whenever fire restrictions or area closures are enforced public notice must be given in compliance with 36_2 CFR, section 1.7.

Procedure for enacting Fire Restrictions

The Fire Management Officer shall have the responsibility to identify areas of the parks where fire restrictions and emergency closures for fire prevention purposes should be implemented. The Fire Management Officer will consider: weather data, fuels data, visitor use trends, on-park fire situation (number of going fires and their potential, probability of new starts, and on-park suppression resource draw-down) and current adjoining National Forest fire restrictions

Once a need is established for enacting restrictions, the parks will complete the actions outlined in the table below. The same process will be used to reduce or cancel fire restrictions. (Extra columns are provided in the table below to serve as a checklist for documentation during fire season.)

Table M-1: Procedures for implementing fire restrictions

Actions to Enact Restrictions						
The Fire Management Officer will recommend to the Chief Ranger and Superintendent the appropriate Stage that should go in to effect.						
The District Fire Management Officers will consult with their respective Management Teams.						
The Fire Information Officer (FIO) will prepare a draft news release announcing and explaining the new restriction.						
A copy of the news release will be approved/signed by the Superintendent and kept in the files as the decision memorandum. If possible, notification to park employees will be made from the superintendent's office. Every attempt will be made to provide at least one week notice before a change is made to the Stage in effect.						
The FIO will issue the approved news release. Every attempt will be made to provide at least one week notice before a change is made to the Stage in effect.						
The FIO will notify all park visitor center information desk personnel.						
The FIO will notify all District Rangers, Sub-District Rangers, and District FMOs.						
The FIO will notify the Wilderness Office.						
The FIO will notify all park entrance stations.						
The FIO will notify park concessionaires.						
The FIO will notify fire dispatchers at Inyo, Sierra, and Sequoia National Forests, and Tulare and Fresno Ranger Units—CAL Fire.						
The FIO will post the new current Stage on the park website.						
Fire personnel will coordinate the posting of signs						
Park Dispatch will announce daily the current Stage during the morning report broadcast, and put Stage information in the written morning report.						

STAGE 1 – HIGH

[See Table M-2 for exact Stage 1 restrictions.]

Trigger Conditions:

If two of the three following conditions are met, Stage 1 fire restrictions will be implemented.

- Foothills annual grass has cured to about the 6,000-foot level for all exposures.
- Fire restrictions for adjoining National Forests are in effect.
- National Fire Danger Rating Staffing Class for any Park fire weather station is three or higher.

Signage

Signs will be posted at the South Fork campground; Hospital Rock and Ash Mountain picnic areas; the Visitor Centers; the entrance stations; the North Fork, Middle Fork, South Fork, Roads End, Hotel Creek, and Don Cecil trail heads; the “Swinging Bridge” near Potwisha campground, and the Indianhead parking area.

STAGE 2 – VERY HIGH / EXTREME

[See Table M-2 for exact Stage 2 restrictions.]

Trigger Conditions (in addition to Stage 1):

If either of the following two conditions are met, Stage 2 fire restrictions will be implemented.

- National Fire Danger Rating Staffing Class for any Park fire weather station is four or five.
- Park firefighting resources are drawn-down fifty percent or more.

Signage

In addition to the locations in Stage 1, signs will be posted at Potwisha and Buckeye Flat campgrounds, Cedar Grove Village picnic area, and all other park trailheads.

STAGE 3 – EXTREME

[See Table M-2 for exact Stage 3 restrictions.]

Trigger Conditions (in addition to Stages 1 and 2):

If both of the following two conditions are met, Stage 3 fire restrictions will be implemented.

- National Fire Planning Level is at 4/5.
- NFDRS indices are consistently at Extreme for at least 2-3 days a week.

Signage

In addition to the locations in Stage 1 and 2, signs will be posted at Azalea, Atwell Mill, Canyon View, Cold Spring, Crystal Springs, Dorst, Lodgepole, Moraine, Sentinel and Sheep Creek campgrounds.

Special Signage During 4th of July

Special "NO FIREWORKS" signs will be posted throughout the Parks seven days prior to, and seven days after the 4th of July holiday. The District Fire Management Officers will coordinate the posting of the signs with Sub-District Rangers.

Fire Restrictions for Sequoia & Kings Canyon National Parks

Table M-2: Fire Restrictions for Sequoia & Kings Canyon National Parks

Stage Level	Designated Campgrounds	Designated Picnic Areas	Wilderness	Smoking
Stage 1 High	Wood and charcoal fires (including wood-burning stoves) are prohibited in South Fork campground. All fires and stoves are allowed in all other campgrounds.	Wood and charcoal fires (including wood-burning stoves) are prohibited in Hospital Rock and Ash Mountain picnic areas. All fires and stoves are allowed in all other designated picnic areas.	Wood and charcoal fires (including wood-burning stoves) are prohibited below 6,000 feet. Year-round elevation/site-specific wilderness fire restrictions also apply. Refer to the Minimum Impact Restrictions. Gas, propane, alcohol (with and without a shutoff valve), and tablet/cube stoves are permitted.	No smoking below 6,000 feet, except within an enclosed vehicle, a building in which smoking is allowed, a campground or picnic area where wood and charcoal fires are allowed, or a designated smoking area.
Stage 2 Very High	Wood and charcoal fires (including wood-burning stoves) are prohibited in South Fork, Potwisha, and Buckeye Flat campgrounds. Gas, propane, alcohol (with and without a shutoff valve) and tablet/cube stoves are permitted.	Wood and charcoal fires (including wood-burning stoves) are prohibited in Hospital Rock and Ash Mountain picnic areas. Gas, propane, alcohol (with and without a shutoff valve) and tablet/cube stoves are permitted.	Stage 2 restrictions are the same as for Stage 1.	Stage 2 restrictions are the same as for Stage 1
Stage 3 Extreme	Wood and charcoal fires (including wood-burning stoves) are prohibited at all elevations. Gas, propane, alcohol (with and without a shutoff valve) and tablet/cube stoves are permitted.	Wood and charcoal fires (including wood-burning stoves) are prohibited in all picnic areas. Gas, propane, alcohol (with and without a shutoff valve) and tablet/cube stoves are permitted.	Wood and charcoal fires (including wood-burning stoves) are prohibited at all elevations. Gas, propane, alcohol (with and without a shutoff valve) and tablet/cube stoves are permitted.	No smoking at any elevation except within an enclosed vehicle, a building in which smoking is allowed, or a designated smoking area.

Note: Employee housing and private property throughout the parks will be treated the same as the nearest campground.

Regulating Access to Hazardous Areas

Coordination between fire overhead and District Rangers and Sub-district Rangers is essential. Fire overhead can recommend to District Rangers action that should be considered. It is the District Ranger's responsibility to determine actual regulatory measures that will be taken to ensure visitor and employee safety on trails, roads, campsites and in developed areas. Fire overhead will coordinate with the District Ranger about who will physically be responsible for making signage postings and physically closing trails or roads.

Most fire operations need only limit access to some front country trails for short periods of time and alternative routes are available to the public. In these cases simply regulating trail use with the use of signs and physically blocking trails is adequate and formal Special Order closures are usually not needed. Special Order closures should be used in situations that involve substantial area, complexity and long duration, such as no other alternative trail routes are available or road access needs to be blocked.

Warning signs should be posted anytime there are fire-caused risks to the public or employees from hazards in a burn area involving trails, roads, campsites and developed areas. Signs must have the following basic information included:

Warning Signs

- WARNING
- NATURE OF THE HAZARD
- STEPS TO TAKE TO AVOID THE HAZARD

Closed Area Signs

- DANGER
- THE AREA THAT IS CLOSED
- THE HAZARD CAUSING THE CLOSURE

Area closure and hazard warning signs require posting outside of the hazard area on routes entering the hazard area. The trail or road should be physically blocked with barricades, on roads, or "trail blocks" made of rope and flagging tape on trails. Hazardous situations may require posting "trail block" personnel if it is likely people may ignore the trail closure--such as backpackers hiking through on long trips may not want to turn back or use alternative routes.

_____________________________ ___________________

Park Superintendent Date

Sequoia and Kings Canyon National Parks

HOT WORK PERMIT

Hot Work Permitting

Hot work shall only be performed in *designated* or *permit-required* areas. Before hot work operations begin in a non-designated location a signed Hot Work Permit will be issued by the park Fire Management Officer, Kings District FMO, or Sequoia District FMO or their designee.

Hot Work Permits are required for:

- Welding within or adjacent to wildland fuels
- Blasting within or adjacent to wildland fuels
- Any other Activity which could potentially result in a wildfire
- Times when Hot Work Permits are required
- During Stage 1 or 2 Fire Restrictions

Any time period the park FMO or District FMO's feel the environmental conditions warrant Hot Work Permits.

Designated Area

A designated area shall be a specific area designed for, or approved by the park FMO or District FMO's or their designee for such work. All designated areas shall have been inspected and approved by the park FMO or District FMOs or their designee.

Permit-Required Area

A permit-required area shall be an area that is made fire safe and authorized by the issuance of a signed NPS Hot Work Permit.

The Hot Work Permit shall be signed by the park FMO or District FMO's or their designee.

Non-permissible use of Hot Work Permit

Hot work shall not be allowed for the following uses:

- In areas not authorized by the park FMO or District FMO's their designee
- Outside areas specified above.
- Construction material burning (No construction debris may be burned pursuit to rule 4103 of the San Joaquin Valley Air Pollution Control District.)
- Vegetation Burning. This form is not to be utilized for the permission of vegetation burning. A Separate Fire Management office Permit for Burning Slash Piles is required.

Hot Work Permit
(Form HW-2)

General

Location:

Describe activity which poses fire hazard:___________________________________

Date and time of proposed activity:____

Proposed actions to minimize risk of wildfire:________________________________

Person Performing Work____

Contractor Business Name:____

Contractor Representative:____

Contractor Contact Number:____

Additional terms and conditions of Hot Work Permit:_____________________________________

This Hot Work Permit is effective from _______________________to_______________________

Park FMO or District FMO (or designee)

Signature :______________________________________ Date:_________________________

PERMIT FOR BURNING SLASH PILES

Permit Authority: 36 Code of Federal Regulations, sections 1.5, 1.6, 1.7 and 2.13.

Issued To:____

Address: ____

City/State/Zip: ____

Telephone Number(s): ____

Location of Piles: ____

Attach map(s) that show the location of slash piles (if available).

Number of Piles: ______________ Approximate total cubic footage: _______________

Burning Time: shall be confined to the hours between 9:00 AM and 4:00 PM. This permit is valid during the period:

_________________________________to _______________________________

This permit is subject to the following terms and conditions.

- The burner agrees to begin burning only after receiving verbal permission on the day prior to, or on the day the burn is to commence from the park Fire Management Office, (559) 565-3164 or 565-3165. Verbal permission must be received on a daily basis if new pile ignitions are made beyond one day. Burning may be prohibited during periods of high to extreme fire danger and/or due to air quality regulations.
- The burner agrees to only burn slash piles that are made of naturally occurring, vegetative fuels that are derived from fire hazard fuel reduction or hazard tree removal projects. No manufactured materials shall be burned including all kinds of construction materials.
- The burner must not burn during very hot and dry periods when winds are strong enough that burning would be considered unsafe. (Example: wind keeps leaves in motion or extends a light flag or cloth).
- The fire shall be confined within cleared fuel breaks or barriers adequate to prevent it from escaping control. The burner will maintain the ability to suppress any spot fires.
- The fire shall be attended at all times by at least one prudent and responsible person who will maintain control of the fire.

This permit does not relieve the permit holder of any responsibility concerning reasonable and ordinary care to prevent damage to the property of others or injury to persons as prescribed by law.

In addition to this permit, the burner is required to obtain an annual "*permit for pile burning in hazard reduction and prescribed burning*" from the San Joaquin Valley Unified Air Pollution Control District. Burning shall only be conducted on approved burn days, and only during daylight hours. Burn day information is available through the Air District via a recorded message at 877-429-2876. The Air District has the authority to independently investigate reports of nuisance smoke, regardless of permit status. Violators may be fined. Annual burning permits may be obtained from; NPS Grant Grove Fire Station, Cal Fire Stations in Squaw Valley, Sand Creek, Badger, and Three Rivers.

Additional terms:

____

I agree to comply with the terms and conditions of this permit.

Signed: ____Date: _______________

Applicant

CAUTION: YOU CAN BE HELD LIABLE FOR ESCAPED FIRES INCLUDING DAMAGE AND SUPPRESSION COSTS. VIOATIONS OF ANY BURNING PERMIT TERMS OR CONDITIONS ARE A VIOLATION OF FEDERAL LAWS AND RENDERS THE PERMIT NULL AND VOID.

****

Approved by:______________________________________Date:______________

Park or District Fire Management Officer

Original copy to Fire Dispatch.

Copy to: permit holder, District Fire Management Officer, and District Ranger.

N - Templates for Prescribed Burn Plans and Mechanical Plans

PRESCRIBED FIRE PLAN

Administrative Unit	Sequoia & Kings Canyon National Parks	
Prescribed Fire Name	Prescribed Fire Burn Plan Template	
Prepared by		
	Name &Qualification/Currency	Date
Technical Review by		
	Name & Qualification/Currency	Date
Recommended By		
	Parks Fuels Management Specialist	Date
Recommended By		
	District Fire Management Officer	Date
Recommended By		
	Park Fire Management Officer	Date
Recommended By		
	Chief Ranger	Date
Complexity Rating	________________________	
Minimum Burn Boss Requirement	________________________	
Approved By		
	Agency Administrator (printed name)	Date
	Agency Administrator (signed)	Date

TABLE OF CONTENTS

Prescribed Fire Name____

Ignition Unit Name____

Note: Text with this gray highlight throughout elements 4-21 is boiler plate text that can be and is normally used in all burn plans. The preparer must still review the text to ensure its relevance and accuracy.

EXECUTIVE SUMMARY

Include a brief 1-2 paragraph synopsis describing the purpose and justification of the project, connection with the overall management of the unit, and description of how it implements the Fire Management Plan. Include things such as the size, location, scheduling, costs, fire return interval, fire history, maintenance versus restoration, and any specific/critical impacts/issues the plan addresses.

This plan has been reviewed by an Interdisciplinary Team and has been found to be within the scope and effect of the Environmental Assessment for the Sequoia and Kings Canyon National Parks Fire and Fuels Management Plan.

Prescribed Fire Name ____

Ignition UnitName____

ELEMENT 2A: AGENCY ADMINISTRATOR IGNITION AUTHORIZATION

Instructions: The Agency Administrator Ignition Authorization must be completed before a prescribed fire can be implemented. If ignition of the prescribed fire is not initiated prior to expiration date determined by the agency administrator, a new authorization will be required.

Prior to signature the agency administrator should discuss the following key items with the fire management officer (FMO) or burn boss. Attach any additional instructions or discussion documentation (optional) to this document.

Key Discussion Items

A.	Has anything changed since the Prescribed Fire Plan was approved or revalidated? *Such as drought or other climate indicators of increased risk, insect activity, new subdivisions/structures, smoke requirements, Complexity Analysis Rating.*
B.	Have compliance requirements and pre-burn considerations been completed? *Such as preparation work, NEPA mitigation requirements, cultural, threatened and endangered species, smoke permits, state burn permits/authorizations.*
C.	Can all of the elements and conditions specified in Prescribed Fire Plan be met? *Such as weather, scheduling, smoke management conditions, suitable prescription window, correct season, staffing and organization, safety considerations, etc.*
D.	Are processes in place to ensure all internal and external notifications and media releases will be completed?
E.	Have key agency staffs been fully briefed about the implementation of this prescribed fire?
F.	Are there circumstances that could affect the successful implementation of the plan? *Such as preparedness level restrictions, resource availability, other prescribed fire or wildfire activity*
G.	Have you communicated your expectations to the Burn Boss and FMO regarding if and when you are to be notified that contingency actions are being taken?
H.	Have you communicated your expectations to the Burn Boss and FMO regarding decisions to declare the prescribed fire a wildfire?

Implementation Recommended by:

FMO or Prescribed Fire Burn Boss Signature:_________________________Date:_______________

I am authorizing ignition of this prescribed fire between the dates of ___________ and ________ ______. It is my expectation that the project will be implemented within this time frame and as discussed and documented and attached to this plan. If the conditions we discussed change during this time frame, it is my expectation you will brief me on the circumstances and an updated authorization will be negotiated if necessary.

Additional Instructions or Discussion Documentation attached (Optional): Yes ☐ No☐

Ignition Authorized by:

Agency Administrator Signature and Title:______________________Date:_______________

Prescribed Fire Name____

Ignition Unit Name____

ELEMENT 2B – PRESCRIBED FIRE GO/ NO-GO CHECKLISTS

AGENCY ADMINISTRATOR GO/NO-GO PRE-IGNITION APPROVAL CHECKLIST

Preliminary Questions	Circle YES or NO	
A. Have conditions in or adjacent to the ignition unit changed, (for example: drought conditions or fuel loadings), which were not considered in the prescription development? If **NO** proceed with the Go/NO-GO Checklist below, if **YES** go to item B	YES	NO
B. Has the prescribed fire plan been reviewed and an amendment been approved; or has it been determined that no amendment is necessary? If **YES**, proceed with checklist below. If NO, STOP: Implementation is not allowed. An amendment is needed.	YES	NO

GO/NO-GO Checklist	Circle YES or NO	
* Have ALL permits and clearances been obtained?	YES	NO
* Have ALL the required notifications been made?	YES	NO
* Have ALL the pre-burn considerations and preparation work identified in the prescribed fire plan been completed or addressed and checked?	YES	NO
* Have ALL required current and projected fire weather forecast been obtained and are they favorable?	YES	NO
* Are ALL prescription parameters met?	YES	NO
* Are ALL smoke management specifications met?	YES	NO
* Are ALL planned operations personnel and equipment on-site, available and operational?	YES	NO
* Has the availability of contingency resources applicable to today's implementation been checked and are they available?	YES	NO
* Have ALL personnel been briefed on the project objectives, their assignment, safety hazards, escape routes, and safety zones?	YES	NO
If all the questions were answered "YES" proceed with a test fire. Document the current conditions, location and results. If any questions were answered "NO", DO NOT proceed with the test fire: Implementation is not allowed.		
After evaluating the test fire, in your judgment can the prescribed fire be carried out according to the prescribed fire plan and will it meet the planned objective? Circle: YES or NO		

* Items required if checklist is modified *

Burn Boss Signature:_________________________________Date:_____________________

Prescribed Fire Name ____

Ignition UnitName____

ELEMENT 3: COMPLEXITY ANALYSIS SUMMARY

Use the NWCG Prescribed Fire Complexity Rating System Guide (PMS 424) to work through the complexity process. Be thorough yet concise with the rating. This is the only stand alone part of a burn plan that requires the Line Officer's signature.

ALL OF THESE FINAL RATINGS MUST MATCH THE FINAL RATINGS IN THE COMPLEXITY ANALYSIS IN APPENDIX C.

PRESCRIBED FIRE NAME			
ELEMENT	RISK	POTENTIAL CONSEQUENCE	TECHNICAL DIFFICULTY
1. Potential for escape			
2. The number and dependence of activities			
3. Off-site Values			
4. On-Site Values			
5. Fire Behavior			
6. Management organization			
7. Public and political interest			
8. Fire Treatment objectives			
9. Constraints			
10. Safety			
11. Ignition procedures/ methods			
12. Interagency coordination			
13. Project logistics			
14. Smoke management			

COMPLEXITY RATING SUMMARY	
	OVERALL RATING
RISK	
CONSEQUENCES	
TECHNICAL DIFFICULTY	
SUMMARY COMPLEXITY DETERMINATION	
RATIONALE: In the final complexity rationale, put yourself in the shoes of the Park Superintendent. What information would you want to know about this burn in 1-2 paragraphs? Give a brief synopsis of the risk they, and the NPS, are taking on by signing this plan, and the potential consequences of that risk. For most burns, especially at the high complexity, a sentence or two of how that risk is being mitigated is probably appropriate. This rationale must be identical to the rationale at the end of the complexity analysis on page 38.	

Prescribed Fire Name____

Ignition Unit Name____

ELEMENT 4: DESCRIPTION OF PRESCRIBED FIRE AREA

A. Physical Description

1. Location

County, State
Township, Range, Section, AND/OR
UTM Zone, Easting, Northing (approximate mid-point of the unit), AND/OR
Longitude, Latitude (approximate mid-point of the unit in decimal degrees / NAD83)

2. Size – Self Explanatory

3. Topography

Upper and lower elevation range.
Slope maximum, minimum, average.
Aspect(s).

4. Project Area.

Describe the unit boundaries in relationship to the cardinal directions.

5. Ignition Units

If the burn is segmented, include acreages of all individual segments. Briefly describe the segments in relationship to each other (e.g. – segment one is located in the northern third of the unit, etc.)

6. Wilderness Status? Designated / Recommended / Study Area / Eligible / Non-wilderness (circle one).

NOTE: All of the above wilderness statuses require a Wilderness Minimum Requirements Analysis (Appendix H) except for non-wilderness burns.

B. Vegetation/Fuels Description.

1. On-site fuels data

Describe the composition of the vegetation types and fuel characteristics (loading, continuity, arrangement, etc). List the predominant species (with both common and Latin names) in the over and understory along with the corresponding fuel model. Include any pertinent history (i.e. large bug kills, past human practices, etc.) contributing to the current vegetative component.

2. Adjacent fuels data

Describe the vegetation and fuels outside the unit if they differ significantly from inside the burn unit. Include fuel models.

3. Percent of vegetation type and fuel model(s)

List the percentage of the unit that is comprised of each fuel model. (As of 2009 SEKI switched to the Scott and Burgan fuel models. This information can be found on the burn unit's fuels map.)

Prescribed Fire Name ____

Ignition UnitName____

Vegetation Type	Scott and Burgan Fuel Model	Estimated Acres	Estimated Tons Per Acre

Total Estimated Project Tons:

Average Tons Per Acre:

Identify where the above tons per acre were derived from. This will usually be done by using the closest match of the Scott and Burgan fuel models to the NFFL fuel models and then using the appropriate tab on the "Fuels 2011 Master_CORRECT" spreadsheet located on the J drive. Include the footnote from the spreadsheet to indicate how the tons per acre were derived.

NOTE: As of 2010 fuels personnel started installing Rapid Assessment Plots (RAP) in most individual burn units. Under some circumstances, tons per acre may be derived using the RAP data instead of the master fuel loading spreadsheet. If FMH plots are present and have been recently read, that data may also contribute to a unit's tons per acre. Contact the Park Fuels Specialist about a particular burn unit.

A. Description of Unique Features:

Identify all sensitive species and features. Include cultural resource mitigation/clearance procedures and describe the consultation with Park Archeologist as required. If sensitive features require protection, describe in detail how this will be accomplished.

NOTE: Do not attach sensitive cultural resource information, files, or locations to any burn plan.

The Burn Boss will report to the park archeologist the discovery of cultural artifacts.

Identify all trees of special interest and whether the burn is located in or near a Special Management Area. Include any necessary mitigations.

Refer to the appropriate appendix for the completed Wilderness Minimum Requirements Analysis as required.

D. Maps: (see attached project, vicinity, smoke trajectory, and other maps as required. Consider adding a fire history map if the unit is surrounded by old burns.)

ELEMENT 5: OBJECTIVES

A- Objectives:

1. Safety objectives:

2. Resource and prescribed fire objectives:

3. Education objectives:

4. Special features objectives:

Specific objectives for the above categories shall be stated in quantifiable and measurable terms with a time element. Objective categories are not necessarily limited to the above. Although not required by interagency policy, goals may be included in this section as well. Objectives can be found in the SEKI Fire and Fuels Management Plan.

ELEMENT 6: FUNDING

A. Cost:

Item	Planning	Preparation	Execution	Evaluation
Personnel – Base 8				
Personnel – Overtime				
Personnel – Contract Crew				
Equipment (mileage, rental)				
Aircraft				
Supplies (non-rolling stock)				
Phase Costs				

Total Estimated Cost: ________________________

Estimated Cost Per Acre: ______________________

Estimated costs must match the allocated funding requested for the burn. (Check with the Park Fuels Specialist.)

If base 8 funding is required to be embedded in the project cost, include the following paragraph.

NOTE: Base 8 personnel costs in the table above are a proportion of the funding for seasonal and/or permanent fuels staff for the fiscal year that are required to be from actual projects.

B. Funding source: Check with the Park Fuels Specialist for the appropriate FBMS account number. Each prescribed burn will usually have its own WBS assigned.

Prescribed Fire Name ____

Ignition UnitName____

ELEMENT 7: PRESCRIPTION

These are generalized prescription parameters. The burn boss is responsible for addressing topographic features outside the range listed in order to meet their burn objectives (usually accomplished by varying the firing pattern, sequence and rate of ignition).

A. Prescription Narrative:

Briefly describe how the desired fire behavior will meet objectives (e.g. – backing fire will be employed to minimize scorch under old growth sugar pines, head fire will be employed to induce brush mortality, etc).

B. Prescription Parameters:

1. Environmental Prescription:

See the SEKI Fire and Fuels Management Plan, Appendix E for prescriptions. SEKI prescriptions were developed for the NFFL fuel models. Use the NFFL fuel model prescription which is the closest match to the new Scott and Burgan fuel models. Refer to the Scott and Burgan guide for the actual crosswalk. (The vegetation itself has not changed, only the fuel model name; therefore the NFFL prescriptions are still valid.) Prescriptions should be based on the predominant fuel model(s) and should include temperature, relative humidity, wind speed, and fuel moistures for the appropriate size classes. Depending on the fuel model, prescriptions may be for both head and backing fire spreads.

2. Fire Behavior Prescription:

These <u>must</u> match the fire behavior outputs from BEHAVE runs based on the environmental prescription and should include at a minimum rate of spread, flame length, scorch height (if appropriate), mortality (if appropriate), spotting distance at the hot end (optional), and probability of ignition at the hot end (optional). BEHAVE runs should be ran with the new Scott and Burgan fuel models and should include runs for both head and backing fire spreads at the hot and cool end of the prescription to get the entire range of outputs.

NOTE: Outputs for the Adequate Holding Resources Worksheet will require “size”, “contain”, “spot”, and “ignite” BEHAVE runs.

ELEMENT 8: SCHEDULING

A. Ignition Time Frames/Season(s): self-explanatory

B. Projected Duration: self-explanatory, include burn down times.

C. Constraints: Dates when burn will not be conducted:

1. No-burn day as determined by San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD).
2. National or Regional Preparedness Levels preclude new prescribed fires unless approval given by regional and national offices.
3. Burn area is not in prescription.
4. Holiday weekends unless approved by the Park Superintendent.

Prescribed Fire Name____

Ignition Unit Name____

ELEMENT 9 - PRE-BURN CONSIDERATIONS AND WEATHER

A. Considerations:

1. On Site:

Describe fireline preparation, hoselays, pump set up, snagging, warning signs, fuel moisture sampling, fuel loading sampling or Rapid Assessment Plot set up, spot weather forecast, trail/area closure notification, etc, with an approximate timeline. Include measures to survey proposed handlines for invasive weeds and/or rare plants as required through the burn plan scoping process. Discuss if and how fuel loading sampling will occur. Indicate the locations where fuel moisture samples will be taken.

2. Off Site

Include the requirement of an Incident Action Plan, logistics, smoke coordination, E-BAM placement, standard notifications, etc, with an approximate timeline.

B. Method and Frequency for Obtaining Weather and Smoke Management Forecast(s):

Describe the spot weather forecast process for the burn. Indicate whether a nearby RAWS station is acceptable for this purpose.

C. Notifications:

Include Fire Information Officer, Visitor Centers, Concessionaires, Ranger Stations, Wilderness Office, Fee Office, local media, Air District, local cooperators, adjacent landowners where appropriate, District Ranger for road and area/trail closures, etc.

ELEMENT 10 - BRIEFING

Briefing Checklist (additional items may be added):

- ☐ Burn Organization and Assignments
- ☐ Prescribed Fire Objectives and Prescription
- ☐ Description of Prescribed Fire Project Area
- ☐ Expected Weather and Fire Behavior
- ☐ Communications
- ☐ Ignition plan
- ☐ Holding Plan
- ☐ Contingency Plan and Assignments
- ☐ Wildfire Conversion
- ☐ Safety and Medical Plan

a.

- ☐ Aerial Ignition Briefing (if aerial ignition devices will be used)

Prescribed Fire Name ____

Ignition UnitName____

ELEMENT 11: ORGANIZATION AND EQUIPMENT

A. Positions:

Specify MINIMUM number and type of resources needed. What is written here MUST BE FOLLOWED when actual implementation/operation of the burn occurs. List all the minimally required overhead by position. It is allowable to have two organizations, one for the hot end and one for the cold end. If this is done, it is important to define what constitutes the hot versus cold end. The resources listed in this section must meet the needs of the Adequate Holding Resources Worksheet (Appendix E).

NOTE: FEMO'S ARE NO LONGER A REQUIRED POSITION ON SEKI BURNS. If a Burn Boss desires a FEMO they should put it in the burn plan as one of the following:

1 Lead Fire Monitor (FEMO) (if available)

OR

1 Lead Fire Monitor (FEMO) (trainee acceptable)

Include an organization chart.

B. Equipment: related directly to operations in general terms (include things lik engines and portable pumps, but it is not necessary to include specific amounts of hose, fittings, etc.)

C. Supplies: related to logistics in general terms (it is not necessary to include specifics).

ELEMENT 12: COMMUNICATION

A. Radio Frequencies

1. Command Frequency(s): list the anticipated frequency(s) and tones with a disclaimer that they are subject to change the day of the burn.

2. Tactical Frequency(s): list the anticipated frequency(s) with a disclaimer that they are subject to change the day of the burn. Include a frequency for traffic control if necessary.

3. Air Operations Frequency(s): list the anticipated frequency(s) with a disclaimer that they are subject to change the day of the burn.

B. Telephone Numbers:

Identify required phone numbers such as fire dispatch, fire information, park dispatch, Visitors Centers, Ranger Stations, Concessionaires, Air District, Wilderness Office, Fee Office, adjacent landowners, etc.

ELEMENT 13: PUBLIC AND PERSONNEL SAFETY, MEDICAL

A. Safety Hazards:

Refer to the attached JHA's (prescribed burning and hazard tree in Appendix D). Identify significant hazards affecting both the public and firefighters. Typical hazards are snags, smoke concerns, roadways, steep terrain, aerial ignition, etc.

B. Mitigation Measures Taken to Reduce the Hazards:

Address the use of PPE, briefings, proper communication, appropriate red cards for positions, work/rest guidelines, driving regulations, warning signs, specific traffic plans, etc.

C. Emergency Medical Procedures:

Reference the use of EMTs and the chain of command for notification of injuries. Ensure it is understood that medicals are handled by the main Park Dispatch Center even if they occur on a prescribed burn. Address whether a back board and trauma kit will be prepositioned on the unit.

In case of a serious injury, the Burn Boss will designate a medical Incident Commander who will supervise the incident within an incident. All medevacs will be coordinated through the Park Law Enforcement Dispatch Center.

Attach and refer to a completed ICS-206 Medical Plan (which would be used in the IAP) as Appendix G.

D. Emergency Evacuation Methods:

Reference ground transportation methods and air transportation opportunities. Refer to the attached completed ICS-206 Medical Plan in Appendix G.

E. Emergency facilities:

Refer to the attached completed ICS-206 Medical Plan in Appendix G.

ELEMENT 14 TEST FIRE

A. Planned location:

Identify parameters associated with the test fire and what specific results will be observed. Allow for flexibility in regards to location.

B. Test Fire Documentation:

1. Weather conditions on-site will be documented by the fire monitors and included in the post-burn monitoring report.

2. Test fire results will be documented by the fire monitors and included in the post-burn monitoring report. Documentation of the test fire timing and success will be done by the Burn Boss on an ICS-214 unit log and communicated to fire dispatch.

ELEMENT 15: IGNITION PLAN

A. Firing Methods (including Techniques, Sequences and Patterns):

In 1-2 paragraphs, indicate whether this is hand and/or aerial ignition (with aerial ensure minimum requirements analysis is addressed). Discuss which technique or combination (i.e. – strip, spot lighting, ring firing, etc.) will be used. Describe the firing sequence and expected firing team stagger in general terms. Allow for flexibility throughout the discussion.

Include the follow sentence if there are roadways within or surrounding the burn.

Firing within 100 feet of roadways will generally employ a backing fire technique to minimize mortality and the creation of hazard trees.

B. Devices:

List the devices needed for ignition.

C. Minimum Ignition Staffing:

Discuss firing teams, firing boss, use of firing team leaders, etc. This should be linked to the burn organization chart in element 11. Allow for flexibility.

ELEMENT 16: HOLDING PLAN

A. General Procedures for Holding:

Describe holding procedures in general terms. Allow for flexibility.

B. Critical Holding Points and Actions:

List the critical holding point(s) and any mitigations that will be in place.

C. Minimum Organization or Capabilities Needed:

This section should be linked to what is listed in element 11. Include reference to the appropriate documentation based on BEHAVE runs (Appendix F), line production rates, etc, for what resources are needed. While the Adequate Holding Resources Worksheet (Appendix E) is now optional, it may in fact be the easiest form to use for documentation. If the worksheet is used, attach it as an appendix and refer to it here. It is allowable to have two organizations, one for the hot end and one for the cold end. If this is done, it is important to define what constitutes the hot versus cold end.

ELEMENT 17: CONTINGENCY PLAN

A. Management Action Points or Limits:

NOTE: There is a MAP table on page A-10 of the 2013 Interagency Prescribed Fire Planning and Implementation Guide that could be useful to define specific management action (trigger) points. The burn plan preparer has the option of using this table for each identified point.

If holders are experiencing control problems such as more slopovers or spot fires than they can handle or control problems in more than one area simultaneously, this should trigger the activation of this contingency plan. Other events which could trigger a contingency activation include such things as adverse smoke impacts to sensitive targets or exceeding prescription parameters on the hot end. Activation of the contingency plan does not automatically constitute an escape or conversion to a wildfire.

The Burn Boss will make the decision when to activate the contingency plan. In the event this occurs, the Burn Boss will document this action and notify fire dispatch and the Fire Management Officer. The regional fire management office will be notified of the contingency activation as soon as it is practical.

B. Actions Needed:

In the event the contingency plan is activated due to holding problems, the additional resources listed below may be ordered to assist holders in bringing the perimeter back under control. Ignition will cease at an appropriate cut off point. All other resources assigned to the burn will be assigned either suppression or holding duties. After control objectives are achieved, the Burn Boss may elect to release the contingency resources if control is no longer deemed a problem.

Refer to element 19 concerning actions to be taken if smoke management necessitates activating the contingency plan.

NOTE: IF NO CONTINGENCY RESOURCES ARE LISTED IN ELEMENT 17C BELOW, THE ABOVE PARAGRAPH WILL NEED TO BE EDITED TO TAKE OUT ALL REFERENCES TO CONTINGENCY/ADDITIONAL RESOURCES.

C. Minimum Contingency Resources and Maximum Response Time(s):

Contingency resources are no longer required to be on site with the NPS. List all needed resources by type with required response times based on fire behavior expected at the hot end of the prescription in element 7. It is allowable to have two contingency lists, one for the hot end and one for the cold end. If this is done, it is important to define what constitutes the hot versus cold end.

Due to the remote locations of many of the burns at SEKI, ensure that contingency time frames are realistic and allow for delayed responses.

If no contingency resources are listed, justify thoroughly through the use of the Adequate Holding Resources Worksheet (Appendix E).

ELEMENT 18: WILDFIRE CONVERSION

A. Wildfire Declared By:

The Burn Boss will make the declaration of a wildfire and document this action. Per interagency policy, the burn will be declared a wildfire if the on-site and contingency resources are unable to contain or confine any spot fires and/or slopovers by the end of the next burning period. Additional resources will be ordered as necessary from local fire agencies or from out of the area through fire dispatch. The escape will be managed under the Incident Command System. All suppression actions will be done using minimum impact suppression tactics whenever feasible in accordance with the SEKI Fire and Aviation Management Operations Guide (FAMOG).

NOTE: IF NO CONTINGENCY RESOURCES ARE LISTED IN ELEMENT 17C ABOVE, THE ABOVE PARAGRAPH WILL NEED TO BE EDITED TO TAKE OUT ALL REFERENCES TO CONTINGENCY/ADDITIONAL RESOURCES

B. IC Assignment:

If a spot fire or slopover occurs, the Holding Supervisor(s) will usually lead the suppression actions and oversee operational aspects under the direction of the Burn Boss as the Incident Commander. If the Burn Boss does not have the appropriate qualification for the complexity of the wildfire, the Duty Officer will order a qualified Incident Commander. The Duty Officer in conjunction with the Burn Boss will determine if the escape and prescribed burn can be managed as one incident. If they must be managed as two separate incidents, an additional Incident Commander will need to be ordered.

C. Notifications:

Fire dispatch will be notified immediately of significant spotting, slopovers, or escape. Burn personnel will go through the main Park Dispatch Center to notify fire dispatch after hours. The Burn Boss will immediately notify the Duty and Fire Management Officers of the change in status from prescribed burn to a wildfire. The Chief Ranger, Park Superintendent, and the regional fire management office will be immediately notified by fire dispatch of the change in the burn's status.

D. Extended Attack Actions and Opportunities to Aid in Fire Suppression:

NOTE: While this section is now optional, it is a good idea to include something in here. In addition to the text below, include whether there are potential contingency lines or features outside the unit (e.g. – accessible logging roads, dip sites, old burn units, rock, etc) that could aid in suppression. This information could also be incorporated into the Holding and Contingency Plans if relevant.

If the fire is declared a wildfire, ignition will cease at an appropriate cut-off point, and all fire personnel will become holding and/or suppression forces. Firing, holding, and monitoring bosses will account for their personnel and be assigned to a division of the fire with their crews by the Burn Boss. A tactical chain of command will be pre-identified by the Burn Boss at the initial briefing.

A Wildland Fire Decision Support System document (WFDSS) will be completed to aid in the selection of management alternatives/objectives. The WFDSS document completion will involve fire management staff, ranger staff from the affected district, and resource management staff at a minimum. Should an external Incident Management Team be ordered to manage the suppression action, the Superintendent will issue a Delegation of Authority. The suppression Incident Commander will report directly to the Fire Management Officer unless otherwise directed in the delegation.

ELEMENT 19: SMOKE MANAGEMENT AND AIR QUALITY

A. Compliance:

Per the local interagency Unified Guidelines and Procedures for Smoke Management, the burn will be registered with the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) in the preceding spring. The smoke management plan will be submitted for approval to the Air District a minimum seven days in advance. Smoke management plans will be submitted through the Prescribed Fire Information Reporting System (PFIRS).

List the estimated emissions in the following table (data must be obtained by using the *SJVUAPCD Emissions Reporting Form* located on the J drive). When estimating emissions, consider the percent consumption based on anticipated fuel moistures and the amount of unburnable area within the unit.

Estimated Emissions (in tons)

Fuel Type	Acres	Tons per acre	PM10	PM2.5	NOX	SO2	VOC	CO

B. Permits to be Obtained:

One week prior to the targeted ignition date, a Planned Ignition Forecast Advisory (PIFA) will be requested from the Air District. At this time the Fuels Management Specialist or designee will begin participation in the daily smoke management conference call and work directly with the Air District to receive the approval to proceed with ignition.

Air District staff will be consulted about the execution of the burn before ignitions take place, including new ignitions that would occur after breaks in firing of a day or more. On a no burn day, no new ignition will occur unless needed for safety and holding purposes, or after approval is obtained from the Air District. SEKI fire staff will discuss the fire situation with the Air District on a regular basis or when there are significant changes with the burning operation and conditions.

C. Smoke Sensitive Receptors:

List the smoke sensitive areas within 15 miles of the burn on the following table.

Smoke Sensitive Area	Distance From Burn Unit	Compass Direction From Burn Unit	Population	Critical Receptors

D. Potential Impacted Areas:

Describe any potential impacts to the above listed smoke sensitive areas. Include the following:

Estimated Smoke Emission Time Period:

Desirable Smoke Dispersal Transport Winds Direction and Speed:

Undesirable Smoke Dispersal Transport Winds Direction and Speed:

Estimated Day Time Smoke Plume Direction and Potential Impact:

Estimated Night Time Smoke Plume Direction and Potential Impact:

Logging of Information Requests and Smoke Complaints:

Prescribed Fire Name ____

Ignition Unit Name____

All contacts will be recorded at Park Visitor Centers and dispatch centers. Receiving parties will determine whether the contact is for the purpose of information or to lodge a formal complaint against the park.

The Burn Boss will be notified of all contacts and consult with the Duty Officer regarding Air District notification in case of formal complaint. The Burn Boss will review complaints and coordinate with the Fire Information Officer in contacting complaining parties to discuss the nature of the complaints. Complaints will be investigated by fire staff to determine the severity of the situation causing the complaint and will determine mitigation steps needed to solve the problem. This information will be given to the Air District as soon as possible.

E. Mitigation Strategies and Techniques to Reduce Smoke Impacts:

If smoke impacts become a major issue affecting management of the fire, ignition will cease at the appropriate cut-off point until conditions that are more favorable for smoke dispersion develop. Topography and firefighter safety will limit or prevent the use of mid-slope containment lines or check lines to halt burning operations. Consequently, the fire may be allowed to back through the unit at a slow rate of spread. If appropriate, the ignition pattern will be regulated to reduce smoke production. The need for aggressive mop-up will be evaluated and implemented as needed in order to mitigate an established smoke impact problem. The impacts to natural resources will need to be weighed against the benefits of aggressive mop-up.

NOTE: THE ABOVE PARAGRAPH WILL NEED TO BE EDITED IF IT IS POSSIBLE FOR FIREFIGHTERS TO CUT OFF FIRE SPREAD IN THE MIDDLE OF A UNIT. AN EXAMPLE OF THIS WOULD BE UNITS IN FLAT TERRAIN WITH LIGHTER FUELS, SUCH AS THE CEDAR GROVE VALLEY FLOOR.

NOTE: THE PARAGRAPH BELOW ALONG WITH THE ROAD CONTROL GUIDELINES MAY BE OMITTED IF THERE ARE NO ROADWAYS IN THE BURN VICINITY WHICH COULD BE IMPACTED. AN EXAMPLE OF THIS WOULD UNITS IN THE UPPER EAST OR MIDDLE FORKS OF THE KAWEAH DRAINAGE.

Minimum acceptable visibility and speed limits, or traffic control, for all public roadways will be enforced by speed limit signs or traffic controllers. Any compromised roadway conditions should be relayed to the Burn Boss immediately, day or night, on shift or off shift.

Road Control Guideline for Two Lane, Two Way Road, Day Light Hours:

Posted Speed Limit	Minimum Acceptable Visibility
10 mph	56 feet if less than 56 feet begin one-way traffic control
15 mph	100 feet
25 mph	216 feet
35 mph	370 feet
45 mph	566 feet

Prescribed Fire Name____

Ignition Unit Name____

Road Control Guideline for Two Lane, Two Way Road, Night Time Hours:

Posted Speed Limit	Minimum Acceptable Visibility
10 mph	112 feet if less than 112 feet begin one-way traffic control
15 mph	200 feet
25 mph	432 feet
35 mph	740 feet
45 mph	1132 feet

Refer to Element 20E for smoke monitoring procedures.

ELEMENT 20: MONITORING

A. Fuels Information Required and Procedures:

Describe the procedures for sampling dead and live fuel moistures before and during the burn in the necessary size classes. Emphasis will usually be on 1,000 hour and live fuels. Fuel Moisture sampling locations will be coordinated with the burn boss.

One hour fuel moisture will be calculated every hour during ignition by the Lead Fire Monitor to ensure the burn is within prescription.

B. Weather Monitoring (Forecasted and Observed) Required and Procedures:

Identify the nearest RAWS station.

Spot weather forecasts will be requested for each day of ignition. The Lead Fire Monitor will take weather observations every hour (or more frequently if requested by the Burn Boss) during the ignition and burn down phases of the burn. Weather observations will include temperature, relative humidity, wind speed and direction, and any significant cloud cover such as cumulus. All weather observations will be documented and broadcasted over the tactical radio frequency.

C. Fire Behavior Monitoring Required and Procedures:

The Lead Fire Monitor will be responsible for recording fire behavior observations such as flame length, rates of spread, flame zone depth, torching, etc. Fire monitors will determine the frequency of fire behavior observations.

Monitors will maintain constant communication with the Burn Boss, Firing, and Holding Supervisors to ensure safe operations when working within the burn. At no time will Fire Monitor safety be compromised for data collection. It will be at the discretion of the Burn Boss whether or not Fire Monitors will be allowed within the burn unit. Monitors will coordinate all activities with the Burn Boss.

D. Monitoring Required To Ensure That Prescribed Fire Plan Objectives Are Met:

The Burn Boss and Lead Fire Monitor will be responsible for monitoring whether burn objectives are being met during the ignition phase. This includes dead and down fuel reduction, limiting mortality in larger size class timber, and inducing mortality in the shrubs and reproduction, etc.

Identify any Fire Effects plots in the burn unit and who will read them.

Identify if there are any rapid assessment plots in the burn unit and who will do the post-burn reading of them.

Reference whether fire severity will be measured post-burn (usually done by the Fire Effects Crew the following year for burns greater than 100 acres). This could be affected by budget cuts.

E. Smoke Dispersal Monitoring Required and Procedures:

During daylight hours, the Lead Fire Monitor will monitor and document smoke observations on the appropriate form on an hourly basis, or as determined by the Burn Boss. Any significant change in smoke emissions or column/plume behavior will be reported to the Burn Boss. If determined to be necessary by the Burn Boss, the Smoke Technician or designee will canvas the local area at first light to determine whether there were any adverse impacts to smoke sensitive areas overnight.

Indicate whether an E-BAM will be used for smoke monitoring and where it will be set up.

ELEMENT 21: POST-BURN ACTIVITIES

Post-Burn Activities That Must Be Completed:

The Burn Boss, in conjunction with the District Fire Management Officer and/or Duty Officer, will formulate a long term patrol plan until threats to the perimeter are diminished.

Any necessary rehabilitation of temporary firelines and trails will be completed once the Burn Boss has declared the threat of escape to be non-existent. The burn perimeter will be surveyed post-burn for hazards caused by the operation. Hazards will be mitigated based on the threat to firefighter/public safety while considering potential resource damage. Hazard trees along roadways that are unable to be mitigated will be reported to the Park Forester. Saw cuts will be flush-cut and cuts will be buried or disguised to the greatest extent possible. Minimum impact suppression techniques will be utilized to rehabilitate the impacts per the FAMOG. All flagging will be removed and all trash will be picked up. The District Fire Management Officer will work with the District Ranger as to when any closed trails are deemed safe to reopen to the public.

NOTE: IF THERE ARE NO ROADWAYS WITHIN OR SURROUNDING THE UNIT, THE ABOVE PARAGRAPH WILL NEED TO BE EDITED.

Documentation will include:

Fire Dispatch will maintain a fire file with the burn plan, dispatch log, resource orders, spot weather forecasts, OF-288 and CTR forms, Prescribed Ignition Forecast Advisory (PIFA),

Incident Action Plans, Unit Logs, etc. Fire Effects monitoring staff will maintain the fire effects data.

The Burn Boss will maintain an ICS-214 Unit Log.

Prescribed Fire Name____

Ignition Unit Name____

The Lead Fire Monitor will prepare and submit a monitoring report that summarizes weather, fire behavior, and smoke observation data prior to the end of fire season.

The Burn Boss will prepare a Wildland Fire Report, through the Wildland Fire Management Information (WFMI) System, within 10 days after declaring the fire out. All fire records will be stored according to standard procedure.

The Fuels Management Specialist will report the project accomplishments in the National Fire Plan Operational Reporting System (NFPORS) within five days of ignition/project completion

Prescribed Fire Name ____

Ignition Unit Name____

APPENDICES

A. Maps
    1. Vicinity
    2. Project
    3. Smoke Trajectory
    4. Fire History (if needed)
B. Technical Review Checklist
C. Complexity Analysis
D. Job Hazard Analyses
    1. Prescribed Burning
    2. Hazard Trees
E. Adequate Holding Resources Worksheet (if used)
F. Fire Behavior Modeling Documentation or Empirical Documentation (i.e. – BEHAVE runs)
G. Medical Plan (Example)
H. Wilderness and Backcountry Minimum Tool Analysis (if needed)
I. Park Review Comments
J. Smoke Management Plan (attach a printed copy of the smoke management plan from PFIRS to the burn plan)
K. PEPC Documents (NOTE: The Environmental Screening Form [ESF] list of reviewer responsibilities and their ESF comments <u>must</u> be printed out from PEPC and attached to the burn plan. This is done in conjunction with the parks compliance Specialist. SEE PARK FUELS SPECIALIST FOR ADDITIONAL GUIDANCE.

Prescribed Fire Name____

Ignition Unit Name____

A. MAPS

1. Vicinity Map:

IMPORT ALL MAPS DIRECTLY ON THE PAGES FROM THE J DRIVE

Prescribed Fire Name ____

Ignition Unit Name____

2. Project Map:

IMPORT ALL MAPS DIRECTLY ON THE PAGES FROM THE J DRIVE

Prescribed Fire Name____

Ignition Unit Name____

3. Smoke Trajectory Map

IMPORT ALL MAPS DIRECTLY ON THE PAGES FROM THE J DRIVE

Prescribed Fire Name ____

Ignition Unit Name____

4. Fire History Map (if needed):

IMPORT ALL MAPS DIRECTLY ON THE PAGES FROM THE J DRIVE

Prescribed Fire Name____

Ignition Unit Name____

B. Technical Reviewer Checklist

Fill out this checklist based on the guidance provided in the Technical Review section in the *Interagency Prescribed Fire Planning and Implementation Procedures Guide*, PMS 484.
Rate each element in the following table with an "S" for Satisfactory or "U" for Unsatisfactory. Use Comment field as needed to support the element rating.

PRESCRIBED FIRE PLAN ELEMENTS		RATING	COMMENTS
1.	Signature page		
2.	A. Agency Administrator Ignition Authorization, PMS 485		
2.	B. Prescribed Fire GO/NO-GO Checklist, PMS 486		
3.	Complexity Analysis Summary		
4.	Description of Prescribed Fire Area		
5.	Objectives		
6.	Funding		
7.	Prescription: Prescription Narrative and Prescription Parameters		
8.	Scheduling		
9.	Pre-Burn Considerations and Weather		
10.	Briefing		
11.	Organization and Equipment		
12.	Communication/		
13.	Public and Personnel Safety, Medical		
14.	Test Fire		
15.	Ignition Plan		
16.	Holding Plan		
17.	Contingency Plan		
18.	Wildfire Declaration		
19.	Smoke Management and Air Quality		
20.	Monitoring		
21.	Post-Burn Activities		
Appendix A: Maps			
Appendix C: Complexity Analysis			
Appendix D: Agency-Specific Job Hazard Analysis or Risk Assessment			
Appendix E: Fire Behavior Modeling Documentation or Empirical Documentation			
Appendix F: Smoke Management Plan and Smoke Modeling Documentation (Optional)			
Other			

☐ Approval is recommended subject to the completion of all requirements listed in the comments section, or on the Prescribed Fire Plan.

☐ Recommendation for approval is not granted. Prescribed fire plan should be re-submitted for technical review subject to the completion of all requirements listed in the comments section, or on the Prescribed Fire Plan.

Technical Reviewer Signature: _________________ Qualification and Currency: ____________

Prescribed Fire Name ____

Ignition Unit Name____

Date Signed: _____________

Prescribed Fire Name____

Ignition Unit Name____

C. COMPLEXITY ANALYSIS

Prescribed Fire Complexity Rating System Guide Worksheet

Instructions: This worksheet is designed to be used with the Prescribed Fire Complexity Rating descriptors on Page 6.

Use the NWCG Prescribed Fire Complexity Rating System Guide (PMS 424) to work through the complexity process. Be thorough yet concise with the rating. This is the only stand alone part of a burn plan that requires the Line Officer's signature.

Project Name ________________________ Number ______________________

Complexity elements:

Potential for Escape

Risk	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Potential Consequences	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Technical Difficulty	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	

The Number and Dependency of Activities

Risk	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Potential Consequences	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Technical Difficulty	Rationale
Preliminary Rating: Low Moderate High	

Prescribed Fire Name ____

Ignition Unit Name ____

Final Rating: Low Moderate High	

Off-Site Values

Risk	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Potential Consequences	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Technical Difficulty	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	

On-Site Values

Risk	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Potential Consequences	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Technical Difficulty	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	

Prescribed Fire Name____

Ignition Unit Name____

Fire Behavior

Risk	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Potential Consequences	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Technical Difficulty	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	

Management Organization

Risk	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Potential Consequences	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Technical Difficulty	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	

Prescribed Fire Name ____

Ignition Unit Name____

Public and Political Interest

Risk	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Potential Consequences	**Rationale**
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Technical Difficulty	**Rationale**
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	

Fire Treatment Objectives

Risk	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Potential Consequences	**Rationale**
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Technical Difficulty	**Rationale**
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	

Prescribed Fire Name____

Ignition Unit Name____

Constraints

Risk	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Potential Consequences	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Technical Difficulty	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	

Safety

Risk	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Potential Consequences	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Technical Difficulty	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	

Prescribed Fire Name ____

Ignition Unit Name____

Ignition Procedures/Methods

Risk	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Potential Consequences	**Rationale**
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Technical Difficulty	**Rationale**
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	

Interagency Coordination

Risk	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Potential Consequences	**Rationale**
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Technical Difficulty	**Rationale**
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	

Prescribed Fire Name____

Ignition Unit Name____

Project Logistics

Risk	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Potential Consequences	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Technical Difficulty	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	

Smoke Management

Risk	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Potential Consequences	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	
Technical Difficulty	Rationale
Preliminary Rating: Low Moderate High	
Final Rating: Low Moderate High	

Final Rating: Low Moderate High	

Prescribed Fire Name ____

Ignition Unit Name____

COMPLEXITY RATING SUMMARY

RISK OVERALL RATING______________________

POTENTIAL CONSEQUENCES OVERALL RATING______________________

TECHNICAL DIFFICULTY OVERALL RATING______________________

SUMMARY COMPLEXITY RATING ______________________

RATIONALE:

In the final complexity rationale, put yourself in the shoes of the Park Superintendent. What information would you want to know about this burn in 1-2 paragraphs? Give a brief synopsis of the risk they, and the NPS, are taking on by signing this plan, and the potential consequences of that risk. For most burns, especially at the high complexity, a sentence or two of how that risk is being mitigated is probably appropriate. This rationale must be identical to the rationale on the complexity analysis on page 6.

____

Prepared by Date

____

Approved by Agency Administrator Date

Prescribed Fire Name____

Ignition Unit Name____

D. SEKI SPECIFIC JOB HAZARD ANALYSIS

SEKI JOB HAZARD ANALYSIS			
Job Description: Prescribed Burning		Date of last update: 2/6/14	
Division with primary responsibility for this JHA: Fire and Aviation	Last updated by: Ben Jacobs, SEKI Fuels Management Specialist	Reviewed by: John Goss, Sequoia District FMO	Approved by: Ben Jacobs, SEKI Fuels Management Specialist
Required standards and general notes:	10 standard firefighting orders, 18 watch out situations, LCES, jobs conducted according to task book standards, agency training, SEKI Fire Management Plan, and policy found in the Interagency Prescribed Fire Planning and Implementation Procedures Guide.		
Required personal protective equipment:	Full firefighter PPE to include Nomex clothing over cotton underclothes, gloves, fire boots, hard hat, eye protection, ear protection, IA pack, headlamp, fusees, fire shelter, chaps (when needed).		
Typical tools and equipment:	Standard firefighting tools; fusees, drip torches, fire engines, Mark III pumps, hose and hoselays, hand held radios.		

Activity	Potential Hazards	Safe Action or Procedure
Planning and writing burn plans.	Burn Boss, FMO, Agency Administrator and agency liability. Errors in fire behavior and fuel modeling, or other parameters, leading to under predicted fire behavior, inadequate preparation or resources for burn.	Ensure national and agency specific policy is strictly followed per the required standards above. Recheck burn plans and fire behavior/fuel data, compare to field assessments, ensure resource needs are accurate and account for worst-case scenario, and that plan is technically reviewed and signed off according to official protocol.
Pre-ignition.	Inadequate or unclear IAP leading to confusion on assignments. Radio frequencies, safety, tactics, or other IAP information inaccurate or lacking. Overhead not oriented to the burn unit. Burn unit preparation is not complete. Weather/fuel conditions out of prescription, equipment and PPE inadequate or lacking, resources inadequate or unqualified, lack of information on weather and fuels. Medical emergency plans are not established.	IAPs should be clear, thorough, reviewed, and signed prior to ignition. All resources should receive a briefing prior to operations. Burn overhead should scout the unit prior to ignition. Burn Boss or designee should ensure that all preparation has been completed. Spot weather forecasts must be requested each burn day. Confirm that weather and fuel conditions are within prescription. Ensure burn and contingency staffing is adequate, with qualified personnel and functional PPE and equipment (especially drip torches and fuel mix). Make

Prescribed Fire Name ____

Ignition Unit Name____

		certain current information (weather forecasts, radio frequencies, hazards, escape routes/safety zones, other IAP info) is distributed to all relevant personnel and that everyone understands their assignments and the larger operation. Have viable medical emergency plans in place and make them known. Pre-position medical equipment at strategic locations.
Test burn.	Unexpected fire behavior compromising the unit boundary, endangering firefighters, bystanders or resources.	Notify all personnel before lighting. To safeguard against hot fuel mix and unexpectedly volatile conditions, start small. Halt ignitions and reevaluate operation if fire exceeds expected behavior. If fire escapes control lines, cease ignition and concentrate on suppression. Avoid working in smoke if possible. Employ LCES at all times.
Ignition phase.	Improper burn mix. Confusion over operation; communications problems, burn pattern mistakes, fire hazards such as snags, extreme or erratic fire behavior. Aerial ignition.	Ensure burn mix is clearly marked as 3:1 (diesel:gasoline), dated, with initials. Ensure briefing adequate, directions given and understood. All radio operators should be trained on and comfortable with handheld radios and should follow the procedures listed in the SEKI Radio Use JHA. The Firing Boss and igniters should have experience commensurate to complexity of burn. LCES should be established and updated as needed. Complete aerial ignition plan. Do dry runs and communicate to all ground resources when aerial ignition begins and ends.
Holding phase.	Spot fires or slopovers. Smoke inhalation Common fireline hazards.	Ensure firefighters gridding in the green have communication and escape routes. Ensure all spots are anchored, lined, mopped up, and flagged back to the line. Follow standard firefighting procedures. Rotate people out of smoke if possible. Use patrols if smoke exposure excessive. Use LCES, stay hydrated, adapt to changing conditions. Snag hazards should be identified, flagged and monitored. Proper lifting techniques can mitigate strains when moving large material; proper tool use can mitigate cuts and fatigue.
Long work shifts during burn & monitoring.	Fatigue, mental and physical stresses.	Allow breaks when possible, adhere to work/rest ratios and driving regulations, ensure access to food and water.

Prescribed Fire Name____

Ignition Unit Name____

SEKI JOB HAZARD ANALYSIS			
Job Description: Working Around Hazard Trees			Date of last update: 07/31/09
Division with primary responsibility for this JHA: Fire and Aviation	Last updated by: Melissa McKibben	Reviewed by: Melissa McKibben	Approved by: Melissa McKibben

Required standards and general notes:	For chainsaw/cross cut saw operations, fire suppression, prescribed fire operations and other wildland fire related work activities. Interagency Standards for Fire and Fire Aviation Operations (Redbook); Fireline Handbook; Incident Response Pocket Guide; Class A,B,C Faller Task Book. - An excellent reference for hazard tree information is found at: http://www.fs.fed.us/r1/projects/haztree_index.shtml. - Also, http://www.fs.fed.us/r5/spf/publications/fhp-pp-presentations.shtml for California. Know your local forest conditions and hazard tree characteristics. When working around hazard trees, have medical emergency plan in place.
Required personal protective equipment:	All wildland fire PPE (boots, fire shelter, hard hat, goggles/safety glasses, nomex shirts and pants, leather gloves.) Anyone working around saws must wear ear protection and chaps.
Typical tools and equipment:	Wildland fire hand tools (shovel, pulaski, etc.), chain saws/cross cut saws, saw service/repair kits, fuel and bar oil containers, axes and wedges, flagging, handheld radios, spare batteries for radios, first aid kits.

Activity	Potential Hazards	Safe Action or Procedure
Size-up of worksite conditions:	Strikes from falling limbs/trees.	Scout out hazard trees/their indicators and high risk tree species. Perform an initial size-up of potential hazard trees from a safe distance as determined by an assessment of on-site conditions, including the potential for "domino effect" events. Pay particular attention to burning trees and trees with dead or broken tops, dead or broken limbs, hung-up trees, trees with severe leans and other signs of significant weakness (refer to attachment to JHA). Communicate hazards to all resources, flag hazard; implement LCES and other hazard control measures. The mitigation of hazard trees will precede work in affected area. This may be accomplished by avoiding, felling or eliminating tree through other means (blasting, burning, heavy equipment, etc.). If the identified hazard tree cannot be safely removed, the area will be flagged off and fire personnel in the area will be notified to avoid the area. Avoid working around hazard trees whenever possible.

Prescribed Fire Name ____

Ignition Unit Name ____

Falling hazard trees:	Strikes from falling limbs/trees.	Avoid felling trees during high or gusty winds, when lightning activity is occurring or if visibility of tree tops and surrounding area is obscured by darkness, smoke, etc. Fallers have the responsibility to turn down an unacceptably risky assignment. Implement LCES. Establish lookouts, clear out work area and escape routes to safety, etc. Limit exposure to qualified sawyer and, when necessary, swamper. Size up should include tree species, height, diameter, lean, soundness, previous fire damage, fire currently in tree, split or broken top, "widow makers" and other hazard tree indicators. Bore tree if necessary to determine soundness. Walk out and clear the intended lay. Drop tree using established falling procedures. Refer to faller Task Books, other applicable JHAs and any agency specific requirements. As tree begins to fall, keep watch on its top while moving quickly away. If tree movement compromises the primary safety zone, use alternate. Watch for falling tree top, limbs and debris for at least 30 seconds after tree hits the ground.

Prescribed Fire Name____

Ignition Unit Name____

Attachment: Working Around Hazard Trees

Potential Hazard Tree Indicators

NOTE: Trees with the indicators below are not all highly hazardous but should be carefully examined to assess the danger

Indicators – Entire Tree

- Snags – standing dead tree or part of dead tree
- Moderate to severe lean (especially recent)

Crown Indicators

- Loss of needles & leaves
- Discoloration/dieback
- Thinning crown
- Stressed cone crop

Limb Indicators

- Dead/cracked/broken branches
- Fallen limbs on ground
- Rot or conks
- Cavities and cankers
- Mistletoe branches

Bole, Stem, Butt Indicators

- Dead/broken tops
- Forked/multiple tops
- Bole swelling
- Cracks or splits
- Cavities and cankers
- Rot or conks
- Wounds/damage – mechanical or fire
- Loose bark

Root & Tree Base Indicators

- Sprung roots – mounded soil or exposed roots
- Compaction & erosion
- Damage from previous fire(s)
- Wind-throw
- Basil resin flow
- Rot or conks
- Cracks or splits

Other Indicators

- Smoke or fire is visible in tree
- Area experiencing insect and/or disease infestations

Prescribed Fire Name ____

Ignition Unit Name ____

Assessment Techniques – Potential Hazard Trees

NOTE: Potential hazard trees should be carefully inspected from top to bottom, including soil next to base of the tree. The assessment must include all sides (360°) of tree. Binoculars can aid in evaluating indicators higher in the tree. Much of hazard tree assessment is subjective and dependent on the skill level and experience of the inspector.

- Look for indicators of hazard and assess the degree of severity. Consider severity versus probability.
- Try to determine if decay or rot is associated with the hazard indicators, which makes failure more likely.
- Thump, bore, and dig as needed to assess conditions not immediately visible.
- Striking bole with a solid object (such as flat end of axe) will aid in hearing the hollow sound of a tree with advanced decay. Boring a tree will also reveal how sound the wood is.
- Digging around the roots may reveal if they are green & sound or are they dead, rotten, burned off or otherwise damaged.
- Evaluate wind (especially wind speed and variability in wind direction)
- What other safety hazards exist (uncontrolled fire, steep slopes, obscured visibility, aviation operations, power lines, etc.)?

Risk Mitigation Measures – Identified Hazard Trees

- Utilize LCES (Lookouts, Communications, Escape Routes & Safety Zones) whenever working in the vicinity of hazard trees.
- Eliminate identified hazard trees (consider all techniques such as saw, burn, blast, cable, heavy equipment).
- Use traffic control when felling trees in the vicinity of roads, trails, firelines, etc.
- Ensure that felling operations do not endanger nearby workers. Avoid working down slope of felling activities.
- If unable to eliminate an identified hazard tree, it should be flagged and avoided.
- Identified hazard trees that can't be eliminated must be communicated to all other employees working in the area.
- Reassess situation as conditions change.

JHA Analysis Interagency Task Group

Paul Chamberlin – U.S. Fish & Wildlife Service
Al King – National Park Service
John Pronos – U.S. Forest Service
Brit Rosso – National Park Service
Louis Rowe – National Park Service

Federal Fire and Aviation Safety Team

Rod Bloms – U.S Fish & Wildlife Service
John Gould – Bureau of Indian Affairs
Ed Hollenshead – U.S. Forest Service
Al King – National Park Service
Michelle Ryerson – Bureau of Land Management

Prescribed Fire Name____

Ignition Unit Name____

E. ADEQUATE HOLDING RESOURCES WORKSHEET

Slopover containment resource needs are determined by analyzing the worst case slop over scenario, based on the location along the burn perimeter that poses the most threat of a slopover. Potential spread and fire intensity was calculated for this location using environmental inputs from the hot end of the burning prescription using BEHAVE. The output information provided by the BEHAVE run is then used along with the standard fire line production rates found in the 2004 Fireline Handbook (pages A30-A32) to determine the resources that would be needed to contain the slop over at established time intervals.

Fire Behavior Fuel Model		Specific Conditions	Construction Rate in Chains per Person per Hour**	Chains of Hose lay per Crew Hour # persons in engine crew					Type 1 Hand Crew Scrape*	Type2 Hand Crew Scrape*
				1	2	3	4	5+		
1	Short Grass	grass	4	6	12	24	35	40	30	18
		tundra	1	2	8	15	24	30	9	5
2	Open Timber	all	3	3	7	15	21	25	24	16
3	Tall Grass	all	0.7	2	5	10	14	16	5	3
4	Chaparral	Chap.	0.4	2	3	8	15	20	5	3
		Pocosin	0.7	2	4	10	15	18	4	2
5	Brush (2 ft.)	all	0.7	3	6	12	16	20	6	4
6	Dormant Brush/Hardwood Slash	black spruce	0.7	3	6	10	16	20	7	5
		others	1	3	6	12	16	20	6	4
7	Southern Rough	all	0.7	2	5	12	16	20	4	2
8	Closed Timber Litter	conifers	2	3	8	15	20	24	7	5
		hardwoods	10	10	30	40	50	60	40	24
9	Hardwood Litter	conifers	2	3	7	12	18	22	28	16
		hardwoods	8	8	25	40	50	60	40	24
10	Timber Litter	all	1	3	8	12	16	20	6	4
11	Light Logging Slash	all	1	3	8	12	16	20	15	9
12	Medium Logging Slash	all	1	3	5	10	16	20	7	4
13	Heavy Logging Slash	all	0.4	2	4	8	15	20	5	3

*Sustained line production rates of 20-person crews for Construction, Burnout, and Holding in chains per hour. Allowances have been made in production rates for rest periods and cumulative fatigue.

Prescribed Fire Name ____

Ignition Unit Name____

** These rates are to be used for estimating initial action productivity only. DO NOT use these rates to estimate sustained line construction, burnout, and holding productivity. Initial action may consist of scratch line construction and hot spotting.

Discussion and Assumptions

NOTE: THIS SECTION SHOULD BE THOROUGH AND DETAILED

Discussion:

Discuss the primary area(s) of concern and fuels adjacent to the unit. The primary focus should normally be on the risk the park in incurring from implementing the burn, and how that risk is being mitigated. Indicate that the analysis was run on a worst case scenario or justify why if it wasn't. Refer to the attached BEHAVE runs for support documentation.

Assumptions used for the analysis:

List all the assumptions and why these assumptions were used. Because there are currently no production rates for the Scott and Burgan fuel models, include a reference and justification for the production rates used from the above table.

Recommendations

Describe the overall recommendations.

Prepared By:______________________ Date:_________________

Prescribed Fire Name____

Ignition Unit Name____

ADEQUATE HOLDING RESOURCES WORKSHEET FOR PRESCRIBED FIRE

FOR PRESCRIBED FIRE

Project Name: ___________________ Fuel Models Inside Project Area:___________ Acres: ____________
Prepared By/Date: ______________________________Fuel Models Outside Project Area: _________________

Characteristics	Output type	Modeling Predictions COOL END RX	Modeling Predictions HOT END RX	Unit of Measure
CRITICAL FIRE INPUTS	1 Hr Fuel Moisture			%
	Wind Speed			MPH
	Slope			%
KEY FIRE BEHAVIOR OUTPUTS	Rate of Spread (ROS)			ch/hr
	Fireline Intensity			BTU/ft/sec
	Flame Length			Feet
	Probability of Ignition			%
	Spotting Distance			Miles
	Scorch Height			Feet
FIRE SIZE	Projection Time			Hours
	Forward Spread			Chains
	Backward Spread			Chains
FIRE CONTAINMENT	Method Of Attack			Head/Rear
	Max Escape Target			Acres
	Max Containment Time			Hours
	Total Line Building Rate			Ch/hr
1. Choose greater total line building rate from inside and outside the project area				Ch/hr
2. Estimate potential number spot fires or slopovers at one time:				
3. TOTAL LINE BUILDING RATE NEEDED (multiply line 1 times line 2)				Ch/hr

Production Rates: Ease of Access: POOR-FAIR-GOOD-EXCELLENT (circle)

(Refer to fireline handbook other sources and local knowledge)

On Site Organization	Total # Planned On Burn	Total # Dedicated to Prescribed Fire	Total # Available for Spot Fire or Slopover Control		Line Building Production Rates		Spot Fire or Slopover Line Building Capacity
Overhead				X		ch/hr	
Firing Crew				X		ch/hr	
Holding				X		ch/hr	
Other Personnel				X		ch/hr	
Engine (Crew of 5)				X		ch/hr	
Dozer (Size)				X		ch/hr	
Other				X		ch/hr	
Other				X		ch/hr	
Other				X		ch/hr	
4. TOTAL CAPACITY							
3. TOTAL LINE BUILDING RATE NEEDED (from table above)							
5. DETERMINATION OF ADEQUATE HOLDING RESOURCES (Line 4 minus Line 3)						ch/hr	

Prescribed Fire Name ____

Ignition Unit Name____

If number on line 5 is positive then adequate holding forces will be available. If number is negative, more holding resources are needed.

F. FIRE BEHAVIOR MODELING DOCUMENTATION OR EMPIRICAL DOCUMENTATION (I.E. – BEHAVE RUNS)

ATTACH BEHAVE RUNS HERE

NOTE: BEHAVE runs should back up the rationale for the Adequate Holding Resources Worksheet and support the fire behavior outputs in the prescription in element 7. If not all the BEHAVE runs are attached, indicate where they can be located.

In order to get the entire range of outputs, BEHAVE runs must be done for head and backing fires for both the hot and cool ends.

BEHAVE runs must be done for fuels both inside the unit and outside the unit when the fuel models are different.

Prescribed Fire Name____

Ignition Unit Name____

G. MEDICAL PLAN (EXAMPLE, Grant Grove)

MEDICAL PLAN	Incident Name	Date Prepared	Time Prepared	Operational Period

5. Incident Medical Aid Station

Medical Aid Stations	Location	Park Medics Yes	No
Qualified EMTs	Throughout burn unit		
NPS Rangers	Request via Dispatch		

6. Transportation

A. Ambulance Services

Name	Address	Phone	Para/Park Medics Yes	No
Three Rivers/Exeter	Request via CDF	559-734-7477		
Lodgepole	Request via Dispatch	559-565-3195		
Mineral King	Request via Dispatch	559-565-3195		
Grant Grove	Request via Dispatch	559-565-3195		
Cedar Grove	Request via Dispatch	559-565-3195		

B. Incident Ambulances

Name	Location	Park medics Yes	No

7. Hospitals

Name	Address	Travel Time Air/Ground	Phone		Helipad Yes	No	Burn Center Yes	No
Kaweah Delta	Visalia			559-625-2211		X		X
VMC	Fresno			559-459-4000	X		X	

8. Medical Emergency Procedures

- Burn Boss or Ash Mountain Fire will contact *Grant Grove* Rangers each day of the burn to confirm the staffing and availability of the *Grant Grove* Ambulance and availability of Park Medics.
- Burn Boss or designee will ensure that at least one backboard and trauma kit is positioned at a pre-determined location on the fireline.
- Communication of the incident will follow the guidelines on page 49 of the Incident Response Pocket Guide.
- In the event of a medical emergency provide information to **Park Dispatch**

1. All Injuries to be assessed by supervisor and nearest EMT. Contact the Burn Boss if medi-vac is imminent.
2. Burn Boss will assign a medical IC who will coordinate medi-vac with Park Dispatch.
3. Declare the nature of the emergency and recommended transport (air vs. ground, need for paramedics, etc.):
4. Medical injury/illness? If injury/illness, is it Life Threatening?
5. If Life Threatening then request that the designated frequency be cleared for emergency traffic.
6. Size-up to include: identify nature of incident; number injured; patient assessment(s); and location (geographic and GPS coordinates).
7. Develop a primary plan for patient care, and transportation options.
8. 6a. For ground transport, Medical IC will contact Park Dispatch to order nearest ambulance listed above.
9. 6b. For aerial transport, Medical IC will contact Park Dispatch to request Sky Life Flight, CHP, or Helicopter 552. H-552 will land at the nearest approved SEKI helispot. Other rescue helicopters will land at the Quail Flat parking area (traffic control will be necessary). Helicopter 552 has short haul capability. Burn injuries will require flight to Fresno Regional Community MC.
10. Request resources and/or equipment and/or capabilities needed. (i.e. ALS ambulance, short-haul)
11. Develop contingency plans (The What If?).
12. Identify any changes in the on-scene person-in-charge or medical personnel as they occur.

- Make notification of incident status, termination of medical incident, communicate emergency has been mitigated and resume unrestricted radio communications. Document all information.

Prepared by (Medical Unit Leader)	10. Reviewed by (Safety Officer)

Prescribed Fire Name ____

Ignition Unit Name ____

H. WILDERNESS MINIMUM REQUIREMENTS ANALYSIS

The Mimimum Requirement Analysis Worksheet is required to be completed for all burns within 'Designated / Recommended / Proposed / Eligible' Wilderness areas. This worksheet is located on the parks' shared drive within the SEKI burn plan template. The worksheet can also be obtained by contacting the Fuels Specialist or the Wilderness Office.

The MRA is usually not imbedded in the burn plan; it is attached as a stand alone document. Note that there are signature requirements and that the MRA needs to be approved by the Park Superintendent.

NOTE: This form is periodically updated. Check with the Wilderness Office to ensure you have the most current version.

Prescribed Fire Name____

Ignition Unit Name____

I. PARK REVIEW COMMENTS

Burn Plan Name: ______________________

Please note comments you have concerning this prescribed burn plan.

Park Fuels Management Specialist:

District Fire Management Officer:

Park Fire Management Officer:

Chief Ranger:

Superintendent:

Prescribed Fire Name ____

Ignition Unit Name ____

J. SMOKE MANAGEMENT PLAN

This page is here as a reminder to attach a printed copy of the smoke management plan from PFIRS and does not actually need to be part of the burn plan.

K. PEPC DOCUMENTS (SEE COMMENT ON PAGE 22)

This page is here as a reminder to include the PEPC documents and does not actually need to be part of the burn plan.

MECHANICAL TREATMENT PLAN

National Park Service

Sequoia and Kings Canyon National Parks

Mechanical Fuels Treatment Plan

PROJECT NAME: MECHANICAL PLAN TEMPLATE

Prepared by: Date: _______
Recommended by: ___________________________Date: _______

Parks Fuels Management Specialist
Recommended by: ___________________________Date: _______

District Ranger
Recommended by: ___________________________Date: _______

District FMO
Recommended by: ___________________________Date: _______

Park Fire Management Officer
Recommended by: ___________________________Date: _______

Chief Ranger
Recommended by: ___________________________Date: _______

Natural Resources Management Specialist (Fire)
Recommended by: ___________________________Date: _______

Chief, Resources Management & Fire Management Committee Chair
Recommended by: ___________________________Date: _______

Chief, Cultural Resources and Interpretation
Approved by: ______________________________Date: _______

Park Superintendent
For information about this project contact:
Fire Management Office 559-565-3164/3165
FAX 559-565-3797
24-Hour Park Dispatch 559-565-3341

TABLE OF CONTENTS

Note: Text with this gray highlight throughout elements 2-10 is boiler plate text that can be and is normally used in all burn plans. The preparer must still review the text to ensure its relevance and accuracy.

ELEMENT 1: EXECUTIVE SUMMARY

A brief discussion describing the purpose and justification of the project, connection with the overall management of the unit, potential impacts and mitigations, use of contracted resources, and description of how it implements the fire management plan. Include things such as the size, location, scheduling, costs, and any specific/critical impacts/issues the plan addresses.

This plan has been reviewed by an Interdisciplinary Team and has been found to be within the scope and effect of the Environmental Assessment for the Sequoia and Kings Canyon National Parks Fire and Fuels Management Plan.

ELEMENT 2: DESCRIPTION OF THE FUELS TREATMENT AREA

A. Physical Description

- Location:
- County, State
- Township, Range, Section, AND/OR
- UTM Zone, Easting, Northing (approximate mid-point of the unit), AND/OR
- Longitude, Latitude (approximate mid-point of the unit in decimal degrees / NAD83)
- Size: self-explanatory; if segmented, include acreages of all individual segments.
- Topography:
- Upper and lower elevation range
- Slope maximum, minimum, average
- Aspect(s)

Project Boundary:

Describe the unit boundaries in relationship to the cardinal directions.

Wilderness Status? Designated / Recommended / Proposed / Eligible / Non-wilderness (circle one)

NOTE: All of the above wilderness statuses require a Wilderness Minimum Requirement Analysis (Appendix H) except for non-wilderness projects.

NOTE: Thinning projects are generally not done in the wilderness; therefore the current Wilderness Minimum Requirement Analysis template is not attached

B. Vegetation/Fuels Description:

On-site fuels data

Describe the composition of the vegetation types and fuel characteristics (loading, continuity, arrangement, etc). List the predominant species (with both common and Latin names) in the over and understory along with the corresponding fuel model. Include any pertinent history (i.e. – large bug kills, past human practices, etc.) contributing to the current vegetative component.

List the percentage of the unit that is comprised of each fuel model. (As of 2009 SEKI switched to the Scott and Burgan fuel models. This information can be found on the burn unit's fuels map.)

Vegetation Type	Scott and Burgan Fuel Model	Estimated Acres	Estimated Tons Per Acre

Total Estimated Project Tons:

Average Tons Per Acre:

Identify where the above tons per acre were derived from. . This will usually be done by using the Scott and Burgan fuel models and referring to the appropriate tab on the "Fuels 2011 Master_CORRECT" spreadsheet located on the J drive.

NOTE: It may be difficult to choose the appropriate fuel loading tab, especially if an area has been previously thinned and pile burned. Contact the Park Fuels Specialist and/or Fire Ecologist for assistance.

C. Description of Unique Features:

Identify all sensitive species and features. Include cultural resource mitigation/clearance procedures and describe the consultation with Park Archeologist as required. If sensitive features require protection, describe in detail how this will be accomplished.

NOTE: Do not attach sensitive cultural resource information, files, or locations to any mechanical plan.

The Project Leader will report to the park archeologist the discovery of cultural artifacts.

Identify all trees of special interest and whether the burn is located in or near a Special Management Area. Include any necessary mitigations.

Refer to the appropriate appendix for the completed Wilderness Minimum Requirement Analysis as required.

D. Maps: (see attached project, vicinity, and other maps as required)

ELEMENT 3: OBJECTIVES

A. Objectives:

Safety objectives:

Resource objectives:

Specific objectives for the above categories shall be stated in quantifiable and measurable terms with a time element. Objective categories are not necessarily limited to the above. Although not required by interagency policy, goals may be included in this section as well. Objectives can be found in the SEKI Fire and Fuels Management Plan.

ELEMENT 4: FUNDING

A. Cost:

Item	Planning	Preparation	Execution	Evaluation
Personnel- Base 8				
Personnel-Overtime				
Personnel- Contract Crew				
Equipment (mileage, rental)				
Aircraft				
Supplies (non-rolling stock)				
Phase Costs				

Total Estimated Cost: (does not include base 8 salary paid out of non-project accounts) ________

Estimated Cost Per Acre: ______________________

Estimated costs must match the allocated funding requested for the treatment. (Check with the Park Fuels Specialist.)

If base 8 funding is required to be embedded in the project cost, include the following paragraph.

NOTE: Base 8 personnel costs in the table above are a proportion of the funding for seasonal and/or permanent fuels staff for the fiscal year that are required to be from actual projects.

B. Funding source: Check with the Park Fuels Specialist for the appropriate FBMS account number. Each mechanical project will usually have its own WBS assigned.

ELEMENT 5: STATEMENT OF WORK

- Describe the work being done in relation of the width of the fuel break to the proximity of any values at risk. Be specific about target tree species to be cut and tree species to not be cut. The following bullets are the standard thinning prescription.
- There will be a maximum of 25 trees/acre less than 40 feet in height (approximately 8 inches diameter at breast height), remaining after the thinning.
- All live trees over 40 feet tall will remain uncut. All larger trees remaining will be limbed up to at least six feet above the ground.
- When removing a lateral branch at its point of origin on the trunk or parent limb, the final cut shall be made in branch tissue close to the trunk or parent limb, without cutting into the branch bark ridge or collar, or leaving a stub.
- When removing a dead branch, the final cut shall be made just outside the collar of live tissue. If the collar has grown out along the branch stub, only the dead stub shall be removed. The live collar shall remain intact and uninjured.
- To prevent damage to the parent limb when removing a branch with a narrow branch attachment, the final cut shall be made from the bottom of the branch up.
- Tree branches shall be removed in such manner so as not to cause damage to other parts of the tree, including having the weight of the branch splitting or tearing off the bark.
- Felled trees will be limbed and bucked down to an eight inch top and piled for later burning. Tree boles larger than eight inches in diameter will be left unbucked. All tree boles left will remain in contact with the ground.
- All stumps will be flush cut at ground level and added to the burn piles.
- Larger brush patches will be cut in such a manner as to create a mosaic pattern by removing 50% of the brush.

If disposing of the wood through pile burning the following bullets usually apply:

- Felled trees will be limbed, bucked and piled for later burning. Nearby dead and down logs up to 18 inches in diameter will be bucked and piled.
- Additional dead and down woody material (up to 18 inches in diameter) will be gathered and piled with larger logs limbed, bucked and piled for later burning.
- All flush cut stumps will be added to the burn piles
- Piles shall be appropriately sized and located in openings far enough away from residual vegetation to prevent or minimize scorch.
- Piles shall have a minimum height of three feet and a maximum height of six feet and be teepee shaped.
- Piles shall be located at least 15 feet from any residual green tree in the downhill or side-slope direction from the pile, and at least 20 feet from any residual green tree upslope of the pile.
- Piles are to be located a minimum of 50 feet from private property and/or structures.
- PILES SHALL NOT BE CONSTRUCTED DIRECTLY UNDER POWERLINES.
- Piles shall be constructed reasonably compact and free of soil to facilitate burning.
- Piles shall also be constructed with enough fine material (less than ¼ inch diameter), such as twigs and needles, to easily ignite and burn the pile.
- All piles should have a good base to prevent the pile from toppling.
- Piles shall be covered with durable paper prior to precipitation. Water resistant “Kraft” paper (Clean Burn Kraft Paper, minimum 6’ wide – available from http://www.baileys-online.com/store.html – see attached tear sheet) or approved substitute may be used. No plastic material will be used to cover piles. The covering shall be placed over the center of the pile. The paper shall cover a minimum of 75% of the surface of each pile.
- Pieces of branch wood shall be placed on the top to secure the paper against reasonable wind events.

- PILES WILL BE BURNED AT A LATER DATE PER NPS POLICY UNDER EITHER A PRESCRIBED OR BROADCAST BURN PLAN AT THE DISCRETION OF FIRE MANAGEMENT.

ATTACH AND REFER TO THE "PROPER PILE CONSTRUCTION SPECIFICATIONS" HANDOUT.

If disposing of the wood through firewood the following bullet (or equivalent)may apply:

- Felled trees will be limbed and bucked into firewood lengths (18-24 inches) and either left on the ground or moved to the treatment unit boundary for campground use.

If disposing of the wood and debris through lop and scatter the following bullet may apply:

- All cut dead and downed woody material will be scattered throughout the unit or moved farther away from the structures and be allowed decompose over time.

If the treatment zone will be maintained on a regular and reoccurring basis, the following bullets may apply:

- Established seedlings and saplings will be thinned every 10-15 years to maintain stocking densities at prescribed levels favoring shade intolerant species. The slash generated will be piled and burned or lopped and scattered.
- Cleared brush zones will be maintained by cutting sprouting brush on a 5-10 year cycle. The cut material will be piled and burned.
- Re-accumulations of dead and down woody material will be gathered and pile, along with limbed and bucked larger logs for later burning on a 5-10 year cycle.

NOTE: Check with the Parks Fire Ecologist on the correct treatment interval which should approximate the fire history at the site.

Include any special instructions for the crews (e.g. – restrictions on chainsaw hours, parking restrictions, etc.)

INSERT PRE- AND POST-TREATMENT REPRESENTATIONS USING PHOTO SERIES IF APPROPRIATE.

SAMPLE Pre-Treatment Representation

3-MC-3

Data Associated with Pre Treatment Photo Representation

DATA SHEET

Residue descriptive code 3-MC-3

LOADING

Size class (inches)	Weight (tons/acre)	Volume (ft^3/acre)
0.0 - 0.25	0.8	51
0.26- 1.0	2.7	180
1.1 - 3.0	2.6	209
3.1 - 9.0	10.6	848
9.1 -20.0	26.8	2,257
20.1+	0	0
Total	43.5	3,545

OTHER MEASUREMENTS

Average residue depth	(feet)	1.2
Ground area covered by residue	(percent)	75
Average duff and litter depth	(inches)	1.1
Ground area covered by duff and litter	(percent)	91
Sound residue 3.1-inch diameter and larger	(percent)	88
Rotten residue 3.1-inch diameter and larger	(percent)	12

STAND INFORMATION

Trees over 20-inch d.b.h.

- Dominant species grand fir
- Trees per acre 17
- Average d.b.h. (inches) 22
- Average tree height (feet) 58
- Average crown height (feet) 11
- Estimated crown space occupied (percent) 10

Trees and dead stems under 8-inch d.b.h.

- Dominant species Douglas-fir
- Trees per acre 150
- Average d.b.h. (inches) 2
- Average tree height (feet) 9
- Average crown height (feet) 1
- Estimated crown space occupied (percent) 10

Trees 8- to 20-inch d.b.h.

- Dominant species Douglas-fir
- Trees per acre 156
- Average d.b.h. (inches) 15
- Average tree height (feet) 75
- Average crown height (feet) 27
- Estimated crown space 50

Snags 8-inch d.b.h. and over

- Number per acre 21
- Average d.b.h. 23
- Average height 60

BRUSH INFORMATION

- Dominant species wildrose
- Average height (inches) 17
- Average crown height (inches) 14
- Ground space occupied (percent) 2

GRASS AND FORBS INFORMATION

- Dominant species elk sedge
- Average height (inches) 4
- Ground space (percent) 11
- Estimated weight (pounds per acre)

ASSESSMENT OF FIRE BEHAVIOR AND SUPPRESSION DIFFICULTY

- Spread rate (chains/hour) 3
- Flame length (feet) 4
- Resistance to suppression(chains/man-hour) 1.1

Ecoclass coding CWF3-11

REMARKS

SAMPLE Post-Treatment Representation

Data Associated with Post Treatment Photo Representation

DATA SHEET

Residue descriptive code 1-MC-4-PC

LOADING

Size class (inches)	Weight (tons/acre)	Volume (ft^3/acre)
0.0 - 0.25	0.2	13
0.26- 1.0	2.0	134
1.1 - 3.0	3.8	304
3.1 - 9.0	.5	42
9.1 -20.0	0	0
20.1+	0	0
Total	6.5	493

OTHER MEASUREMENTS

Average residue depth	(feet)	0.01
Ground area covered by residue 1/4-inch diameter and larger	(percent)	89
Average duff and litter depth	(inches)	.1
Sound residue 3.1-inch diameter and larger white fir	(percent)	60
incense-cedar	(percent)	40
	(percent)	
Rotted residue 3.1-inch diameter and larger	(percent)	0

HARVEST INFORMATION		HARVEST INFORMATION SOURCE: Sale records	Onsite estimation
Gross volume	(M fbm/acre) 4.6	x	
Net volume	(M fbm/acre) 4.6	x	
Average stems/acre cut	15	x	
Average d.b.h. of stems cut	(inches) 22	x	
Stand age	(years) 150		x
Cutting prescription	Tree selection	x	
Yarding method	Tractor	x	
Slash treatment	Machine pile & burn		x
Period since cut or treatment	(months) 8		x

ASSESSMENT OF FIRE BEHAVIOR AND SUPPRESSION DIFFICULTY

Spread rate	(chains/hour)	3
Flame length	(feet)	2
Resistance to suppression	(chains/man-hour)	6.0

REMARKS

ELEMENT 6: SCHEDULING

- Ignition Time Frames/Season(s): self-explanatory
- Projected Duration: self-explanatory.
- Constraints: Dates when treatment will not be conducted:
- Chainsaw hours of operation shall be between 0900-1600 hours
- No project operations will be conducted over holiday weekends.

ELEMENT 7: PUBLIC AND PERSONNEL SAFETY, MEDICAL

Safety Hazards:

A Job Hazard Analysis (JHA) will be reviewed by project staff prior to the start of any new work on the project. Existing JHA's that can be used for chainsaw work (falling, bucking, limbing, sharpening), environmental hazards, and driving on narrow park roads and will be made available to project crews.

Identify significant hazards affecting both the public and firefighters.

Measures Taken to Reduce the Hazards:

Address the use of PPE, briefings, proper communication, work/rest guidelines, driving regulations, warning signs, any necessary traffic plans, mechanisms for keeping the public out of the work area, etc.

Emergency Medical Procedures:

Reference the use of EMT's and the chain of command for notification of injuries. Ensure it is understood that medicals are handled by the main Park Dispatch Center. Attach and refer to a completed ICS-206 Medical Plan. Address whether a back board and trauma kit will be prepositioned on the unit.

In case of a serious injury, the Project Lead will designate a medical Incident Commander who will supervise the incident within an incident. All medivacs will be coordinated through the Park Law Enforcement Dispatch Center.

Emergency Evacuation Methods:

Reference ground transportation methods and air transportation opportunities. Refer to the attached completed ICS-206 Medical Plan.

Emergency facilities:

Refer to the attached completed ICS-206 Medical Plan.

ELEMENT 8: NOTIFICATIONS

List the appropriate individuals, agencies, and public to receive notification. Include any of the following if they will be affected. The Fire Information Officer (mandatory), Visitor Centers, Concessionaires, Ranger Stations, Wilderness Office, Fee Office, local media, trail closures, local cooperators, adjacent landowners where appropriate, District Ranger for road and area/trail closures, etc.

Discuss who will coordinate notifications and who will need to be kept up to date on the project's status.

Fire dispatch will be updated on the project status every day that personnel are on site, from execution through rehabilitation. All resource orders will be placed though fire dispatch.

ELEMENT 9: MONITORING

Consult with the Parks Fire Ecologist on the level of monitoring needed for the treatment. Monitoring is of thinning treatment is usually done with photo points. Describe in detail how any photo points will be set up and at what interval they will be re-photographed. Attach a "plot detail" if warranted. See the example in the Appendix.

ELEMENT 10: POST-TREATMENT ACTIVITIES

- Post-Burn Activities That Must Be Completed:
- All trails and roadways near the project area will be surveyed after the completion of the project for hazards caused by the operation. All identified hazards will be mitigated as soon as possible. All saw cuts will be flush-cut. All flagging will be removed and all trash will be picked up.
- Fire Dispatch will maintain a project file with the project plan, dispatch log, resource orders, OF-288 and CTR forms, unit logs, etc.
- The Project Lead will maintain ICS-214 Unit Logs and/or contract daily logs
- The Fuels Management Specialist will report project accomplishment in the National Fire Plan Operational Reporting System (NFPORS) within 5 days of ignition/project completion.

APPENDICES

A. Maps (vicinity and project)
B. Plot Detail (if needed, see attached example)
C. Proper Pile Construction Specifications (attached)
D. Job Hazard Analyses (if necessary)
E. Medical Plan (see attached example)
F. Wilderness Minimum Requirement Analysis (if needed, NOT attached)
G. Park Review Comments

PEPC Documents (NOTE: The Environmental Screening Form [ESF] list of reviewer responsibilities and their ESF comments must be printed out from PEPC and attached to this form. This is done in conjunction with the Parks Compliance Specialist. SEE PARK FUELS SPECIALIST FOR ADDITIONAL GUIDANCE.)

A. MAPS

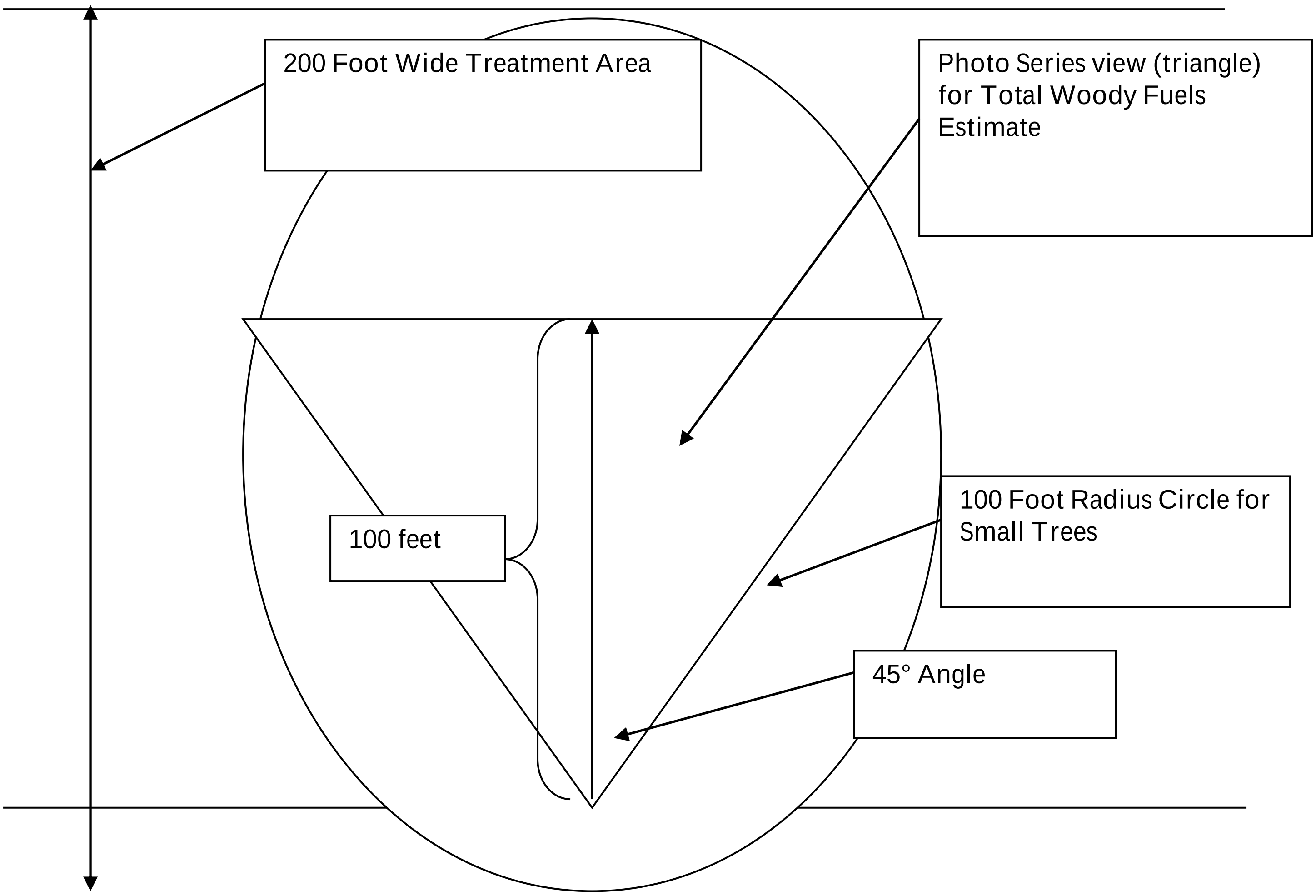
Vicinity Map:

IMPORT ALL MAPS DIRECTLY ON THE PAGES FROM THE J DRIVE.

Project Map:

IMPORT ALL MAPS DIRECTLY ON THE PAGES FROM THE J DRIVE.

B. Sample Plot Detail:



Inside Perimeter

C. Proper Pile Construction Specifications:

SEQUOIA & KINGS CANYON NATIONAL PARKS

Proper Pile Construction:

Follow these guidelines:

- <u>CUT ONLY</u>: **White Fir, Red Fir** and **Cedar.**
- <u>DO NOT CUT</u>: Sugar Pine, Western White Pine, Black Oak and Giant Sequoia.
- CUT ONLY: Trees UNDER 40 feet tall.
- CUT ONLY: Trees LESS THAN 8 inch DBH.
- LIMB remaining standing trees up to 6 feet above ground.

<u>Pile Specifications</u>:

- Construct Piles in "TEEPEE" Shape.
- Construct Piles in Open Areas.
- All Material 1" to 8" go in Pile.
- Pile Height up to 6 feet Tall.
- Mix Pile with Twigs and Needles.
- NO PILES UNDER POWERLINES.
- At Least 20 feet From USFS Boundary.
- Flush Cut Stumps.

MORE INFO ON BACK SIDE →

For Questions, Contact:
Ash Mountain
Fire Dispatch
559 565-3164

Version1, Dec.2006(lau)

D. CHAINSAW JOB HAZARD ANALYSIS

SEKI JOB HAZARD ANALYSIS			
Job Description: Chainsaw Operations			Date of last update: 06/14/09
Division with primary responsibility for this JHA: Fire and Aviation Management	Last updated by: Brandon Ramirez	Reviewed by: John Cielnicky	Approved by: Melissa McKibben

Required standards and general notes:	S-212 Wildland Fire Chainsaws.
Required personal protective equipment:	Hard hat, gloves, Nomex shirt and pants, Kevlar chaps, eye and ear protection, leather boots.
Typical tools and equipment:	Complete saw pack.

Activity	Potential Hazards	Safe Action or Procedure
Preparing saw.	Untrained in sharpening technique. Not wearing proper PPE.	Get training from S-212 class and your supervisor. No tolerance for lack of PPE.
Chain sharpening.	Cuts or abrasions.	Wear gloves and long sleeves, use sharp file and wear eye protection.
Starting saw.	Body contact with blade/bar. Kickback risk, blade contacting bystanders.	Start saw on ground. Make certain area is clear; warn those nearby before starting saw.
Sizing up tree.	Hasty size-up. Tree too hazardous to fall/sawyer unqualified. Widowmakers, dead tops. Unidentified escape routes and safety zones.	Slow down, insure proper size-up. Don't cut! Notify supervisor, contact qualified sawyer. Use spotter, avoid area below hazard. Identify and clear out two escape routes, ideally at 45 degree angles to backcut.
Boring cuts (tree ring sampling).	Kickback risk.	Maintain correct cutting angle at start of cut (lower portion of tip) until saw tip is buried in tree.
Falling trees.	People unaware of falling ops/at risk of self or property being hit by falling trees.	Call out your cuts (back cut/direction of fall). Sawyer shall ensure people are one and one half times the distance of tree length away (or further, based on worst-case scenario such as domino effect with nearby snags). Spotters posted to keep public/traffic out of danger zone. Once tree falls, wait for hanging/flying debris to clear before entering area and issuing all clear.
Falling snags.	Rot and lack of holding wood. Falling unexpectedly due to wind, vibrations from falling trees, extreme root decomposition, etc.	Sound tree or make boring cuts. Account for nearby snags before falling tree, mitigate the hazard.
Limbing fallen tree.	Snap back from compressed limbs and small trees. Tree dropping or rolling after limb is cut.	Remove debris from the area to be worked to better see what dangers exist Do not cut bent saplings or limbs if there is any question of safety. Ensure that tree is not supported by limb you are about to cut.
Bucking fallen tree.	Log rolling, causing injury or property damage.	Cut from the downhill side and work upwards, allowing the final cut to be made from the safer uphill side. Make sure no one below. Secure in trench or parallel to slope if necessary.
Wear proper PPE.	Cut leg, chips in eye, hearing loss, etc.	Wear chaps, safety glasses, gloves, earplugs, and all other required PPE.
Cutting brush, swamping, line construction.	Injuries to self or others due to hasty cutting.	Slow down; ensure good footing and position before cutting. Maintain situational awareness, know where your bar is at all times, and ensure clear path for saw before moving it.

E. MEDICAL PLAN

EXAMPLE (FOR GRANT GROVE)

MEDICAL PLAN	1. Incident Name	2. Date Prepared	3. Time Prepared	4. Operational Period
5. Incident Medical Aid Station				

Medical Aid Stations	Location	Park Medics Yes	No
Qualified EMTs	Throughout burn unit		
NPS Rangers	Request via Dispatch		

6. Transportation				
A. Ambulance Services				
Name	Address	Phone	Para/Park Medics Yes	No
Three Rivers/Exeter	Request via CDF	559-734-7477		
Lodgepole	Request via Dispatch	559-565-3195		
Mineral King	Request via Dispatch	559-565-3195		
Grant Grove	Request via Dispatch	559-565-3195		
Cedar Grove	Request via Dispatch	559-565-3195		

B. Incident Ambulances			
Name	Location	Park medics Yes	No
7. Hospitals			

Name	Address	Travel Time Air	Ground	Phone	Helipad Yes	No	Burn Center Yes	No
Kaweah Delta	Visalia			559-625-2211		X		X
VMC	Fresno			559-459-4000	X		X	

8. Medical Emergency Procedures

- Burn Boss or Ash Mountain Fire will contact Grant Grove Rangers each day of the burn to confirm the staffing and availability of the Grant Grove Ambulance and availability of Park Medics.
- Burn Boss or designee will ensure that at least one backboard and trauma kit is positioned at a pre-determined location on the fireline.
- Communication of the incident will follow the guidelines on page 49 of the Incident Response Pocket Guide.
- In the event of a medical emergency provide information to Park Dispatch

1. All Injuries to be assessed by supervisor and nearest EMT. Contact the Burn Boss if medi-vac is imminent.
2. Burn Boss will assign a medical IC who will coordinate medi-vac with Park Dispatch.
3. Declare the nature of the emergency and recommended transport (air vs. ground, need for paramedics, etc.):
4. Medical injury/illness? If injury/illness, is it Life Threatening?
5. If Life Threatening then request that the designated frequency be cleared for emergency traffic.
6. Size-up to include: identify nature of incident; number injured; patient assessment(s); and location (geographic and GPS coordinates).
7. Develop a primary plan for patient care, and transportation options.
    a. For ground transport, Medical IC will contact Park Dispatch to order nearest ambulance listed above.
    b. For aerial transport, Medical IC will contact Park Dispatch to request Sky Life Flight, CHP, or Helicopter 552. H-552 will land at the nearest approved SEKI helispot. Other rescue helicopters will land at the Quail Flat parking area (traffic control will be necessary). Helicopter 552 has short haul capability. Burn injuries will require flight to Fresno Regional Community MC.
8. Request resources and/or equipment and/or capabilities needed. (i.e. ALS ambulance, short-haul)
9. Develop contingency plans (The What If?).
10. Identify any changes in the on-scene person-in-charge or medical personnel as they occur.

- Make notification of incident status, termination of medical incident, communicate emergency has been mitigated and resume unrestricted radio communications. Document all information.

Prepared by (Medical Unit Leader)	10. Reviewed by (Safety Officer)

F. WILDERNESS MINIMUM REQUIREMENT ANALYSIS

If needed, contact the Fuels Management Specialist or the Wilderness Office for the latest template. The location of the template is also referenced in the Fire and Fuels Management Plan Addendum.

G. Park Review Comments

Project Name:

Please note comments you have concerning this project plan.

Park Fuels Management Specialist:

District Fire Management Officer:

Park Fire Management Officer

Division of Visitor and Fire Management

Division of Resources Management and Science

Division of Interpretation and Partnerships

Chief Ranger:

Superintendent:

Other:

O - Preparedness Staffing/Step-Up Plan

The Step-Up Plan describes pre-approved responses to escalating fire danger. These mitigating actions are designed to enhance the park's fire management capability for short periods (e.g., during one or more burning periods generally lasting less than two weeks; periods of increased visitation such as holiday weekends; or other pre-identified short term events) when normal staffing cannot meet initial attack, prevention, or detection needs.

Breakpoints for each of the 5 staffing levels in this plan were determined by analyzing weather data from the Ash Mountain, Park Ridge, and Cedar Grove RAWS. The NFDRS Burning Index (BI) was selected for Cedar Grove and Ash Mountain stations since these stations are characterized by light fuels and the Burning Index is best reflective of short-term fire danger. These stations best capture changing day-to-day conditions effecting fire response. The Energy Release Component was analyzed for the Park Ridge RAWS. Park Ridge is best characterized by heavy timber fuels and this index and this station best capture the changing seasonal trend in long-term fire danger for the parks. An overall snapshot of daily fire danger in the parks can be captured by averaging the Staffing Levels calculated from each of the three stations.

The 97th and 90th percentiles were used to set breakpoints for Staffing Levels 5 and 4 respectively. The 40th and 26th percentiles were used to set breakpoints for Staffing Levels 3 and 2 respectively. Staffing levels 2 and 3 were determined by adjusting the pre-defined "average" percentiles of 45 and 23 to better reflect earliest fire occurrence and the beginning of escalating fire activity.

Fire Dispatch will calculate the Staffing Level daily and consult with both of the District Duty Officers to reach a consensus on park-wide staffing. If the duty officer believes the calculated Staffing Level is not reflective of current conditions, they may ask the District Fire Management Officer to adjust the calculated Staffing Level. District Fire Management Officers have the authority to adjust calculated staffing down one level if a weather event decreasing fire danger is forecast. District Fire Management Officers also have the authority adjust staffing up one level if any of the following situations occur:

- Increased visitation due to a planned special event
- Red Flag Warning
- Forecasted Lighting Activity Levels of 3 or higher
- One engine is assigned to an active wildland fire in the park, is out of service, or is on an out of park assignment
- Park Ridge ERC is above the 97th percentile

With the concurrence of the Park Fire Management Officer, districts may have different Staffing Levels. The Park Fire Management Officer has the final authority in determining daily Staffing Levels and may adjust calculated staffing up or down one level based on any observable and document table criteria that could have a direct effect on fire activity.

Staffing Level and any need for extended hours will be announced by Fire Dispatch before 1500 hours daily.

Fiscal Controls

The *NPS Wildland Fire & Aviation Annual Financial Management Guide* authorizes parks to establish an account to cover the costs for step-up activities for Staffing Level 4 and 5 as identified in this plan and approved by the superintendent. A separate step-up account must be established for each event requiring a step-up action. For the purposes of this plan, the parks define an event as a single circumstance requiring a step-up action. No single event should cross the end of a pay period nor should any given event exceed 14 days. Intermittent periods of high fire danger occurring within a 14 day period should be considered a single event.

All step-up actions that incur costs must be approved by the Parks' Fire Management Officer and will be assigned an unique Work Breakdown Structure (WBS) along with a unique "firecode" assigned by Wildland Fire Dispatch. Wildland Fire Dispatch, after approval of the action by the Fire Management Officer, will be responsible documenting the justification for the step-up account in WildCAD. The Fire Program Management Assistant will establish and track the account in the Automated Finance System. Justification for the step-up action incurring costs should also be documented in the notes section of the AFS accounting system.

For any event requiring consecutive extended staffing in excess of 14 days the Parks Fire Management Officer will discuss the need for a Severity Account with the Chief Ranger, Park Superintendent, and Regional Fire Management Officer.

STAFFING LEVEL I

Table O-1: Staffing level I

Ash Mtn. Area	Grant Grove/Lodgepole Areas	Cedar Grove Area
BI 0-79	ERC 0-57	BI 0-51

Description

No fire activity is expected. Parks may be asked to fill an interagency resource request.

Duty Officer

None required, but may be identified to help coordinate day-to-day wildland fire management activities. If identified, the Duty Officer should meet Pacific West Regional standards for a low complexity unit (i.e. minimum qualification of Incident Commander Type 4).

Operations

- All fire crew maintain readiness
- Normal tours of duty and number of fire crew personnel
- Extended hours not authorized

Prevention / Communication

Fire danger rating and road signs reflect the highest adjective class for any of the three primary stations reported.

STAFFING LEVEL II

Table O-2: Staffing level II

Ash Mtn. Area	Grant Grove/Lodgepole Areas	Cedar Grove Area
BI 80-146	ERC 58-63	BI 52-57

Description

Minimal fire activity is expected. Initial attack likely to be successful with a single module committed. Parks may be asked to fill an interagency resource request.

Duty Officer

One duty officer recommended for park. Duty officer should meet Pacific West Regional standards for a moderate complexity unit (i.e. minimum qualification of incident commander type 4 and as a task force leader, or any strike team leader, or any two single resource boss positions one of which must be crew boss or engine boss). Currency not required.

Operations

- All fire crew maintain readiness
- Normal tours of duty and number of fire crew personnel
- Extended hours not authorized
- Prevention / Communication
- Fire danger rating and road signs reflect the highest adjective class for any of the three primary stations reported.

STAFFING LEVEL III

Table O-3: Staffing level III

Ash Mtn. Area	Grant Grove/Lodgepole Areas	Cedar Grove Area
BI 147-216	ERC 64-81	BI 58-73

Description

Moderate fire activity is possible. Initial attack likely to be successful with only park resources committed. Parks may be asked to fill an interagency resource request.

Duty Officer

One duty officer required for park. Duty officer should meet Pacific West Regional standards for a moderate complexity unit (i.e. minimum qualification of incident commander type 4 and as a task force leader, or any strike team leader, or any two single resource boss positions one of which must be crew boss or engine boss. Currency not required.

Operations

- All fire crew maintain readiness
- Normal tours of duty and number of fire crew personnel
- Extended hours not authorized
- Prevention / Communication
- Fire danger rating and road signs reflect the highest adjective class for any of the three primary stations reported.

STAFFING LEVEL IV

Table O-4: Staffing level IV

Ash Mtn. Area	Grant Grove/Lodgepole Areas	Cedar Grove Area
BI 217-227	ERC 82-95	BI 74-78

Description

Wildfire with significant spread potential is possible. Initial attack will likely require interagency resources and air support. Multiple starts of moderate to high complexity are possible. Parks may be asked to fill an interagency resource requests.

Duty Officer

One duty officer required for park. Two duty officers, one for each district, are recommended. Duty officer must meet Pacific West Regional standards for a high complexity unit (i.e. minimum qualification of incident commander type 3 and as a division/group supervisor). Currency not required.

Operations

- All fire crews maintain readiness
- Extended hours are not authorized Monday through Thursday unless at least two of the following occur:
- Increased visitation due to a planned special event
- Red Flag Warning
- Forecasted Lighting Activity Levels of 3 or higher
- One engine is out of service or assigned to an active wildland fire in the park or is on an out of park assignment
- Park Ridge ERC is above the 97th percentile
- Fire staffing is at full draw down levels
- Extended hours are authorized Friday through Sunday if at least one of the following occurs:
- Increased visitation due to a planned special event

- Red Flag Warning
- Forecasted Lighting Activity Levels of 3 or higher
- One engine is out of service or assigned to an active wildland fire in the park or is on an out of park assignment
- Park Ridge ERC is above the 97th percentile
- Fire staffing is at full draw down levels
- Hours may be extended for duty officers, fire dispatch, fully staffed engines, and Helitack.
- Crew 91 and Crew 9 may be extended only if the modules have been combined into a single initial attack crew and they are identified as an initial attack resource immediately available for response with fire dispatch. Extended hours for these modules must be approved by the Duty Officer and have the concurrence of the parks' Fuel Specialist or Assistant Fuels Specialist.
- The Arrowhead Interagency Hotshot Crew will not be extended unless requested by a Duty Officer and approved by the park FMO.
- Firefighters may work a sixth day only if necessary to meet full module staffing requirements (i.e. 5 person with 2 CDLs and ENGB per engine / 4 firefighters with 1 HEMG for Helitack).

Prevention / Communication

- Fire danger rating and road signs reflect the highest adjective class for any of the three primary stations reported.
- New slash pile burns prohibited
- Fire management staff will assess the need to implement fire restrictions

STAFFING LEVEL V

Table O-5: Staffing level V

Ash Mtn. Area	Grant Grove/Lodgepole Areas	Cedar Grove Area
BI 228+	ERC 96+	BI 79+

Description

Extreme potential for wildfire with high rates of spread and intensity. Initial attack will very likely require interagency resources and air support. Multiple high complexity starts are possible. Parks may be asked to fill an interagency resource requests.

Duty Officer

One duty officer required for park. Two duty officers, one for each district, are recommended. Duty officer must meet Pacific West Regional standards for a high complexity unit (i.e. minimum qualification of incident commander type 3 and as a division/group supervisor). Currency not required.

Operations

- All fire crews maintain readiness

- Extended hours are not authorized Monday through Thursday unless at least one of the following occurs:
- Increased visitation due to a planned special event
- Red Flag Warning
- Forecasted Lighting Activity Levels of 3 or higher
- One engine is out of service or assigned to an active wildland fire in the park or is on an out of park assignment
- Park Ridge ERC is above the 97th percentile
- Park fire staffing is at full draw down levels
- Extended hours may be authorized Friday through Sunday for authorized resources due to fire danger alone.
- Hours may only be extended for duty officers, fire dispatch, fully staffed engines, and Helitack.
- Crew 91 and Crew 9 may be extended only if the modules have been combined into a single initial attack crew and they are identified as an initial attack resource immediately available for response with fire dispatch. Extended hours for these modules must be approved by the Duty Officer and have the concurrence of the parks' Fuel Specialist or Assistant Fuels Specialist.
- The Arrowhead Interagency Hotshot Crew will not be extended unless requested by a Duty Officer and approved by the park FMO.
- Firefighters may work a sixth day only if necessary to meet full module staffing requirements (i.e. 5 person with 2 CDLs and ENGB per engine / 4 firefighters with 1 HEMG for Helitack).

Prevention / Communication

- Fire danger rating and road signs reflect the highest adjective class for any of the three primary stations reported.
- New slash pile burns prohibited.
- Fire management staff will assess the need to implement fire restrictions.

P - Prescribed and Wildland Fire Reporting Requirements

ANNUAL PRESCRIBED FIRE PROGRAM DOCUMENT

One primary park wide prescribed fire planning meeting is held each winter. The information gathered in the planning meetings forms the basis for the annual SEKI five year fuels treatment plan update. This plan is presented to the Fire Management Committee and the Leadership Team as requested. Proposed individual burn units are entered into the Planning, Environment, and Public Comment (PEPC) system by the Park Fuels Management Specialist for internal park scoping.

PRESCRIBED FIRE OPERATIONS DOCUMENTATION

Burn Boss Responsibilities

Burn Bosses are responsible for completion of Burn Unit Plans, Unit Logs, Wildland Fire Report Forms (formerly known as the DI-1202) for the Wildland Fire Management Information (WFMI) system, and Burn Boss trainee performance ratings. Cost tracking forms and Post Burn Reports are no longer required, but can be completed at the discretion of the Burn Boss. Burn Bosses need to make sure that unit preparation and execution support is coordinated with the appropriate District Rangers and District FMO, and that adequate documentation is provided to Fire Dispatch during burn unit execution. Burn Bosses will provide daily fire situation updates to Fire Dispatch, normally by radio or telephone.

Burn Unit Plan

One plan should be written for all "active" segments within a unit – this saves on duplication of effort and time spent getting the document reviewed and approved. The plan is generally good until all segments are executed or there are major changes in unit/segment planning, and/or NPS policy. However, plans with a shelf life longer than three years should be revalidated and updated as necessary. The Burn Boss has the final say on control line location. Current burn prescriptions are valid as defined in Appendix E in this plan. A burn plan template is available on the park network under J:/seki/park_programs/share_docs/fire/plans/burn_plans/NEW RX PLAN INFO. This template is reviewed and updated annually or as necessary by the Park Fuels Management Specialist. Burn Bosses must use the most current template.

Unit Log

For use in tracking decision and significant actions/events during execution. Originals are archived by Fire Dispatch in the appropriate prescribed burn folder. At a minimum, the Burn Boss will maintain a unit log through the execution phase of the project. Other key positions may be requested to maintain unit logs at the discretion of the Burn Boss. Individuals with poor handwriting are encouraged to submit typed versions to Fire Dispatch. Original notes must be kept available upon request. Unit logs should be submitted to Fire Dispatch as soon as possible.

Wildland Fire Report Forms

For NPS reporting purposes, geographically distinct segments within a unit need to be documented on separate Wildland Fire Report Forms. Different segments of the same unit burned in different calendar years, will require separate Wildland Fire Report Forms.

Thorough Wildland Fire Report Forms take the place of traditional Post Burn Reports and narratives should be concise, yet detailed. Report narratives should include at a minimum, a brief unit description (size, location, fuel type, etc.), synopsis of the burn objectives, whether those objectives appear to have been attained, ignition method, control issues, injuries, smoke issues, list of resources and overhead personnel by name and position on the burn, and other significant events or information.

Provide a chronological narrative of events and decisions.

Use the monitoring data collected to compare what actually happened on the fire to burn unit objectives. Describe, based on monitoring data and your experience, how the fire met objectives. If objectives were not met, explain the problems encountered that prevented meeting objectives.

Attach 7.5 minute maps showing the final fire perimeter.

Unit Log copies can be included with Wildland Fire Report Forms to provide a chronological narrative of events and decisions. Reports are sent directly to Fire Dispatch within 10 days after declaring the fire out.

Trainee Performance Ratings

Burn Bosses are responsible for completion of Individual Performance Ratings (ICS Form 226) and/or Task Books for Burn Boss trainees. Task Books and Individual Performance Ratings for other positions (e.g. – Firing Boss or other holding positions) are the responsibility of the appropriate supervisor. Task Books are initiated and certified through coordination with FMO.

Lead Fire Monitor Responsibilities

Fire Monitoring

Fire monitor reports with concise narratives are required by FMO. Fire Monitors need to gather thorough observation information on several forms for all prescribed fire incidents they are assigned to (see list below). If designated Fire Monitors are not assigned to a burn unit then it is the Burn Boss' (or designees') responsibility to thoroughly document burn unit execution using the same forms. If requested, monitors need to provide copies of all forms to Burn Bosses within a timely manner. All original forms and maps are sent to Fire Dispatch for inclusion in the fire files. Monitoring reports should include general unit description, burn objectives, prescription parameters, incident resources, brief daily summaries, fire behavior, weather, and smoke observations, fire effects and burn objective evaluations, attached forms, photos, and maps. The Burn Boss is responsible for ensuring fire monitor reports are completed by the appropriate individuals.

The Fire Monitoring report template can be found at:
J:\seki\park_programs\share_docs\fire\Ecology\fuels\FEMO Fire Reports

Fire Effects Monitors

Fire effects monitoring protocols are supervised by the park fire ecologist. Plots records remain with the ecologist. FMO works with the ecologist to archive fire effects records.

Smoke and Weather Monitoring Technician

The Smoke and Weather Monitoring Technician compiles data from various observation sensors, archives the data into data packages for prescribed fire operations each fire season under the direction of the Park Air Quality Specialist.

List of Monitoring Forms

(Available at: J:\seki\park_programs\share_docs\fire\Ecology\fuels\FEMO Fire Reports\FEMO Forms)

- Fire Weather and Fire Behavior Observations
- Smoke Observations
- Wildland Fire Observations Record
- Maps showing daily fire spread or ignition, and including locations of fire observations.

Fire Dispatch Responsibilities

Fire Dispatch is responsible for compiling fire planning documents, situation and observation data into individual fire files, and documents fire situation information using a variety of Interagency Reporting Systems. Fire Dispatch maintains burn projects folders which include the original burn plan, dispatch logs, Individual and Crew Time Reports, spot weather forecasts, Incident Action Plans, PIFAs, and all other related burn paperwork. Fire Dispatch also maintains daily fire situation information in several interagency computer systems.

Fire Information Officer Responsibilities

The Fire Information Officer is responsible for compiling media releases and news articles about fire operations. The FIO also coordinates communications about park fire operations with employees through use of email systems.

WILDLAND FIRE REPORTING REQUIREMENTS

Upon report of an unplanned fire event (either human-caused or lightning ignited), the parks record the following information about each fire:

- Lat/Long (Nad83)
- Fire Cause
- Geographic Location

- Elevation
- Fuel Model/Vegetation Type
- Acreage
- Slope
- Aspect
- Fire Behavior
- Spread Potential
- Sensitive boundaries, building or trails
- Natural Barriers
- Access
- Hazards
- Helispot(Lat/Long)

Fire Dispatch Responsibilities

Fire Dispatch is responsible for compiling fire planning documents (WFDSS), situation and observation data into individual fire files, and documents fire situation information. Fire Dispatch submits this information through a variety of reporting systems including:

The Wildland Fire Computer Aided Dispatch (WildCAD). In addition to the basic fire information, WildCAD also tracks the status of fire resources committed to a fire (crews, helicopters, etc.).

The National Fire and Aviation Management Web Applications website (FAMWEB). Fire dispatch submits an ICS Form 209 (Incident Status Summary) to the Geographic Area Coordination Center (GACC) and the National Interagency Fire Center (NIFC) through FAMWEB based upon the California Interagency Mobilization Guide recommendations (Chapter 20, page 12, section 22.2.1, Line 26).

Additionally, the Fire Information Officer reports large fires for the public on Inciweb and a variety of other methods (see Chapter 3, Tool 5).

Unit Logs, dispatch logs, cost documentation, planning documents and other fire documentation is maintained at fire dispatch.

REPORTS FOR BOTH PRESCRIBED AND WILDLAND FIRES

The Fire Management Officer is responsible for the completion of the following:

- Prescribed fire accomplishments into the National Fire Plan Operations and Reporting System (NFPORS
- Contributions to the Annual Superintendent Report

Fire dispatch is responsible for the following reports:

- Wildland Fire Reports in WFMI
- Annual SEKI Fire Summary

The Park Aviation Manager is responsible for:

- Annual SEKI Air Operations Summary

ARCHIVES FOR BOTH PRESCRIBED AND WILDLAND FIRE

The Park Curator supervises the archiving of individual fire files and other important fire history documents into park archives. FMO staff prepares the files following the curator's direction.

Electronic archiving of prescribed fire documents is maintained in the appropriate burn plan folder located on the park network at: J:/seki/park_programs/share_docs/fire/plans/burn_plans. The park fuels management specialist is responsible for the electronic archiving of prescribed fire documents.

Q - Fire Staffing & Minimum Qualifications

The following list is intended to be the park-wide minimum qualifications staffing that supports the average annual on-park fire work load. The list does not include career development, off-park support or special assignments—except for Arrowhead Hotshots.

Table Q-1: List of fire staffing and minimum qualifications

Functional Area	Minimum	Who?
Command		
FUMA	3 from the following list	FMO / DFMOs / RX Spec. / Fire Planner
ICT3	3	FMO / DFMOs
ICT4	9	All Hand Crew and Engine Crew Captains and Helicopter Managers on the HELITACK Crew
ICT5	13	All fire crew first line supervisors, C-91 Squad Bosses, and Helicopter Managers on the HELITACK Crew
IOF3	2	PIO / FIO
RXB1	4 from the following list	FMO / DFMOs / RX Spec. / Fire Planner
RXB2	10 from the following list	FMO / DFMOs / RX Spec. / Fire Planner / All STF Engine Captains / C-91 Leader / H-552 Captain
RXM1	3 from the following list	FMO / DFMOs / RX Spec. / Fire Planner
RXM2	3 from the following list	FMO / DFMOs / RX Spec. / Fire Planner
Finance		
EQTR	1	FMO Budget Assistant
PTRC	4	Kings Dist. Ranger Time Keeper / Sequoia Dist. Ranger Time Keeper / FMO Budget Asst. / A-6 Clerk
TIME	1	FMO Budget Asst.
Logistics		
ORDM	1	Fire Cache Manager
RCDM	1	Fire Cache Manager
Operations		
CPR/First Responder	Everyone including seasonals	EVERYONE
CRWB	5	Crew 91 Leader / H-552 Captain and Helicopter Managers on the HELITACK Crew / Fire Monitor Squad Leader
DIVS	4	FMO / DFMOs / RX Spec.
ENGB	6	All Engine Captains, / Engineers
FALB	13	2 on each engine / 6 on C-91 / 3 on HELITACK
FALC	9	All Engine Captains / Crew 91 Leader and Squad Bosses/ H-552 Captain
HEB2	2	DFMO Sequoia / H-552 Captain
HECM	5	H-552 Crew
HMGB	3	H-552 Captains and Helicopter Managers on the HELITACK Crew
RXI1	5	FMO / DFMOs / RX Spec. / Fire Planner
PLDO	3	H-552 Captain and Helicopter Managers on the HELITACK Crew
RXI2	10 from the following list	FMO / DFMOs / RX Spec. / Fire Planner / All STF Engine Captains / C-91 Leader /

		H-552 Captain
STAM	4	A-6 Clerk / Procurement / Maintenance
Planning		
FBAN	1	RX Spec.
FEMO	5	One on each crew
LTAN	1	RX Spec.
SCKN	4	Kings Dist. Ranger Time Keeper / Sequoia Dist. Ranger Time Keeper / FMO Budget Asst. / A-6 Clerk
Arrowhead Hotshots		
CRWB	5	Superintendent 6 / Captain (2) / Module Leader (2)
EMT-B	2	Skilled Firefighter / Crew Member FALC
FALC	3	Captain / Module Leader / Skilled Firefighter
FFT1	5	Skilled Firefighter (5)
FFT2	10	Crew Members
HECM	2	Skilled Firefighter / Crew Member
ICT3	2	Superintendent 6 / Operations Captain
ICT4	3	Squad Bosses (3)
ICT5	5	Skilled Firefighter (5)
STCR	2	Superintendent 6 / Operations Captain

R - Yearly Readiness Checklist

This checklist is a summary of major fire management activities.

YEAR-ROUND

- Return any and all defective equipment to the Ash Mountain fire cache.

JANUARY

- Complete annual work plan for fire program managers.
- Establish training dates for fire refreshers and other known training.
- Update fire history and WFMI database in GIS.
- Complete all annual fire reports and required reports.

FEBRUARY

- Begin seasonal employee hiring process
- Recruit prospective staff

MARCH

- Continue seasonal hiring process.
- Begin work capacity testing (pack test).
- Re-inventory Ash Mountain Fire Cache.
- Begin clean-up, maintenance, servicing and restocking of all fire vehicles.
- Submit previous years blackened acres to the Air District for billing purposes.

APRIL

- Initiate pack tests.
- Complete seasonal hiring process and track administrative progress with new seasonal employees.
- Complete operations meetings with local cooperators and the Air District.
- Conduct annual spring operations meeting.
- Continue inventory of Ash Mountain fire cache and restock if necessary. Prepare for summer issues.
- Conduct program training course needs analysis for the following year at the module level.
- Red Card Committee prioritizes training course needs at the program level
- Start to look for new replacement vehicles to come in from GSA and get with FMO fleet manager on striping, identification, and other equipment needs.

MAY

- Early May – EOD of seasonal employees.
- Determine additional module internal training course needs. Prioritize courses and select lead instructors.
- Continue clean-up, maintenance, servicing, and restocking of all fire management vehicles.
- Ash Mountain Cache – Begin summer issue of PPE and crew equipment.
- Conduct multiple 8 hour fire refresher sessions throughout the parks.
- Begin daily vehicle readiness checks.
- Activate the Ash Mountain Helibase.
- Prescribed burn plans completed for Superintendent's signature.
- Module Leaders submit updated red card information. (experience/training)
- Green-Up: the Cedar Grove and Park Ridge RAWS and perform annual maintenance.
- Begin collecting fire weather observations and calculating fire danger ratings.
- Start issuing red cards to all fire staff employees.
- Begin internal wildland fire training based on the needs determined under bullet number #2 (e.g. – S-130, 190, 211, 212, 271, Basic Aviation Safety, etc).
- Begin all non-fire related training (POSH, defensive driving, SEKI orientation, update training, CPR/First Responder, etc) per the Fire Module Required Training Checklist.
- Complete engine, patrol vehicle, and station inventory and restock as necessary.
- Complete *Fire Crew Readiness Certification* (Appendix L)
- For Arrowhead complete *Standards For Interagency Hotshot Crew Operations Annual IHC Mobilization Checklist* (Appendix C of that document).
- Complete module readiness reviews.
- Begin fuel moisture and fuel loading sampling (as required, ongoing)
- EOD of the park contract helicopter.
- Conduct all-hands FMO orientation
- Pay previous year's blackened acres fees to the Air District
- Prescribed burning of approved units in prescription

JUNE

- Complete all internal wildland fire training (e.g. – S-130, 190, 211, 212, 271, Basic Aviation Safety, etc).
- Insert and set up the Sugarloaf and Rattlesnake RAWS.
- Establish additional fuel loading plots (as required, ongoing).
- Conduct operational field day for the modules.
- Complete all non-fire related training (POSH, defensive driving, SEKI orientation, update training, CPR/First Responder, etc) per the Fire Module Required Training Checklist.
- Begin mechanical hazard fuel reduction projects.
- Prescribed burn preparation activities.

- Prescribed burning of approved units in prescription.
- Activate all sub-district helispots.
- Conduct employee fire extinguisher use training during safety stand-down
- .Conduct monthly fire shelter training.

JULY

- Continue mechanical hazard fuel reduction projects.
- Prescribed burn preparation activities.
- Prescribed burning of approved units in prescription.
- Continue fuel moisture and fuel loading sampling.
- Conduct weekly and/or daily training sessions on safety, engine operations, chainsaws, portable pumps, and helicopter use.
- Conduct monthly fire shelter training.

AUGUST

- Continue daily fire readiness check of vehicles, equipment, and PPE.
- Continue daily and weekly informal training.
- Continue mechanical hazard fuel reduction projects.
- Prescribed burn preparation activities.
- Continue fuel moisture and fuel loading sampling.
- Prescribed burning of approved units in prescription.
- Conduct monthly fire shelter training.

SEPTEMBER

- Continue daily fire readiness check of vehicles, equipment, and PPE.
- Continue daily and weekly informal training.
- Continue mechanical hazard fuel reduction projects.
- Prescribed burn preparation activities.
- Continue fuel moisture and fuel loading sampling.
- Prescribed burning of approved units in prescription.
- Submit following year’s training course nominations to the Parks’ Training Officer.
- Conduct monthly fire shelter training.

OCTOBER

- Continue daily fire readiness checks of vehicles, equipment, and PPE.
- Continue daily and weekly informal training.

- Continue mechanical hazard fuel reduction projects.
- Winterize all sub-district helispots.
- Continue fuel moisture and fuel loading sampling.
- Complete fuel loading data entry.
- Re-inventory engines, patrol vehicles, and station facilities. Prepare deficiency list for replacement items.
- Request status of yearly vehicle replacement list from the auto shop.
- Submit vehicle replacement memo to FMO fleet manager who will send to auto shop.
- Prescribed burn preparation activities.
- Prescribed burning of approved units in prescription.
- Begin end-of-season vehicle and power equipment winterizing.
- All fire crew leaders-submit updated experience and training (IQCS employee update form) to fire dispatch for yourself and your crewmembers.
- Remove the Sugarloaf and Rattlesnake RAWS from the backcountry.

NOVEMBER

- Prescribed burn preparation activities.
- Prescribed burning of approved units in prescription.
- Continue winterizing all patrol vehicles, pumps, chainsaws, and PPE.
- Perform quality checks of fuels data.
- Prepare and submit monitoring crews' annual reports (including those for individual burns).
- Conduct annual end of season fall operations meeting.

DECEMBER

- Send out chainsaws/pumps for maintenance.
- All Wildland Fire Report Forms completed and entered into WIFMI.
- Prepare requisitions for Ash Mountain Fire Cache and vehicle inventory restocking.
- Analyze and summarize fuel loading data collected during the season.
- Complete previous year's data summary reports for fire monitoring
- Issue Forestry Technician seasonal job announcement.

S - Addendum

Wildfire Response Plan, master copy with fire dispatch

Logistics Plan, Sequoia and Kings Canyon National Parks. Updated 2013. Located with fire dispatch.

Fire and Aviation Management Operations Guide (FAMOG), Sequoia and Kings Canyon National Parks. 2013. Located in Fire Management Office.

Interagency Standards for Fire & Fire Aviation Operations, 2014. Located with fire dispatch and throughout fire operations.

Letters of Agreement (LOA) and Memorandums of Understanding (MOU) binder

Wildfire Prevention Plan: An Operating Plan of the Park Fire Management Program, Sequoia and Kings Canyon National Parks. 1993. Located in Fire Management Office.

Serious Injury or Death Procedure. Plan located with Superintendent's Office, Chief Ranger' s Office, park dispatch, and fire dispatch offices.

Division Safety Plan, Fire Safety Plan, JHAs: located on the parks shared drive.

Aviation Management Plan, Sequoia and Kings Canyon National Parks. 2014 Located in Fire dispatch.

Standard Operating Procedures for the Communication Center

Emergency Equipment Rental Agreement binder

Standard Operating Procedures: Fire & Fuels Information, Sequoia & Kings Canyon National Parks. Located in the Fire Information and Education Specialist's office.

Guidance for Implementation of Federal Wildland Fire Management Policy: http://www.nifc.gov/policies/guidance/GIFWFMP.pdf

WFDSS Objectives and requirements, reference WFDSS document.

Policy Statement Defining "Trees of Special Interest": located on the parks' shared drive.

Minimum Requirement Analysis Worksheet (for Wilderness projects): located in the parks' shared drive.